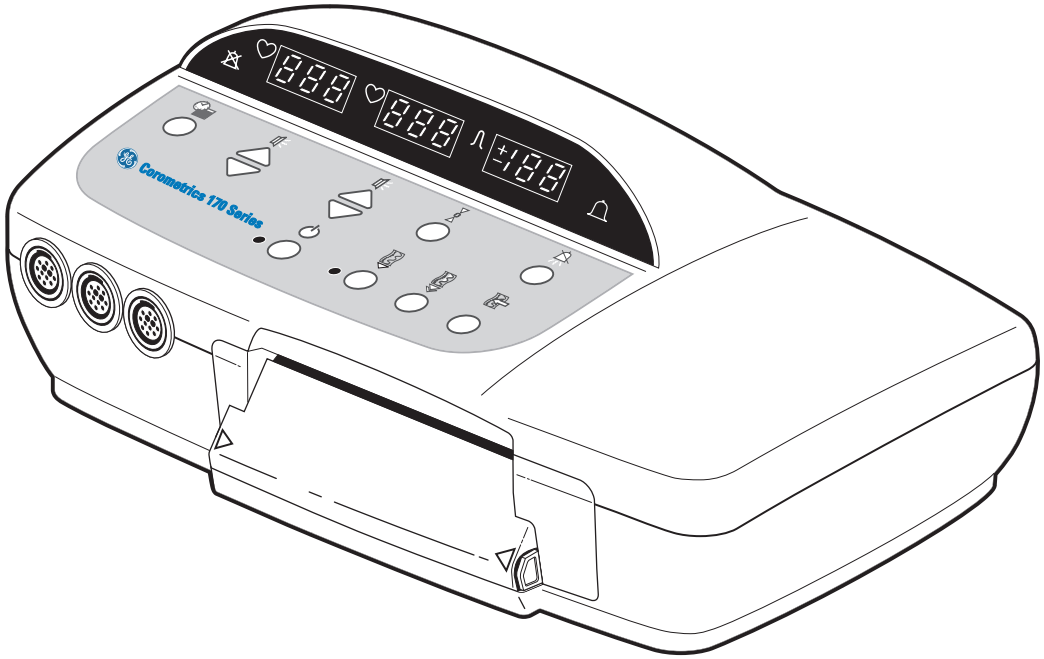
# Corometrics®170 Series

OPERATOR'S MANUAL

MANUAL P/N 2003023-001 REV. D




**GE Medical Systems**

*Information Technologies*

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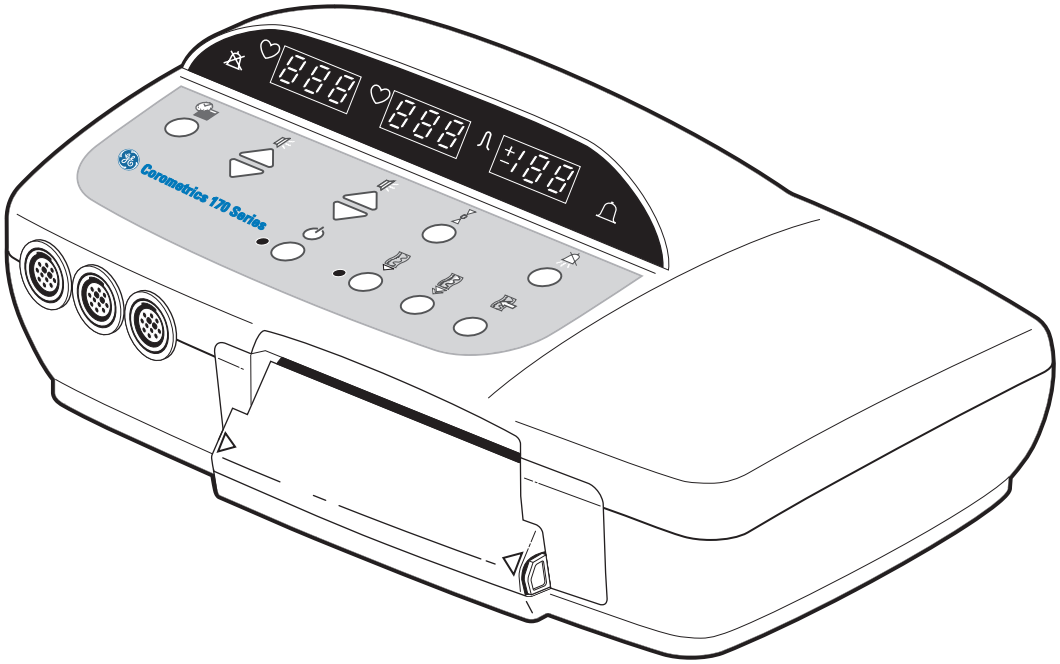


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GE Medical Systems *Information* Technologies
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GE Medical Systems *Information Technologies* will make available on request such circuit diagrams, component diagrams, component parts lists, descriptions, calibration instructions, or other information which will assist the users or appropriately qualified technical personnel to repair those parts of the equipment which are classified by GE Medical Systems *Information Technologies* as repairable. Refer to the service manual for further information.

⚠ **CAUTION:** In the United States of America, Federal Law restricts this device to sale by or on the order of a physician.

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# CE Marking Information

CE 0459

## Compliance

A Corometrics brand 170 Series Monitor bears CE mark CE-0459 indicating its conformity with the provisions of the Council Directive 93/42/EEC concerning medical devices and fulfills the essential requirements of Annex I of this directive.

The device is manufactured in the United States; the CE mark is applied under the authority of Notified Body GMED (0459).

The country of manufacture and appropriate Notified Body can be found on the equipment labeling.

The product complies with the requirements of standard EN 60601-1-2 “Electromagnetic Compatibility—Medical Electrical Equipment” and standard EN 60601-1 “General Requirements for Safety.”

## Components of the Certified Systems

The IEC electromagnetic compatibility (EN) standards require individual equipment (components and accessories) to be configured as a system for evaluation. For systems that include a number of different equipments that perform a number of functions, one of each type of equipment shall be included in the evaluation.

The equipment listed below is representative of all possible combinations. For individual equipment certification, refer to the appropriate declarations of conformity.

Component Description:

- 170 Series Fetal Monitor
- AC-to-DC Power Supply
- Tocotransducer
- Ultrasound Transducers (x2)
- FECG Cable/Legplate
- Model 146 Fetal Acoustic Stimulator
- Remote Event Marker
- RS-232C Interconnect Cables (x2)
- Telemetry Interconnect Cable

## Exceptions

**The Monitor System EMC: Immunity Performance**

None

Be aware that adding accessories or components, or modifying the medical device or system may degrade the EMI performance. Consult with qualified personnel regarding changes to the system configuration.

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# Chapter 1

# ⚠Safety

The information presented in this section is important for the safety of both the patient and operator and also serves to enhance equipment reliability. This chapter describes how the terms Danger, Warning, Caution, Important, and Note are used throughout the manual. In addition, GE Medical Systems *Information Technologies'* standard equipment symbols are defined.

This section includes the following important information:


General Information . . . . . 1-2
Definitions of Terminology . . . . . 1-3
Monitor Safety Information . . . . . 1-4
Definitions of Symbols. . . . . 1-8

# General Information

## General Use

If the monitor is cold to the touch or below ambient temperature, allow it to stabilize to room temperature before use.

To ensure patient safety, use only parts and accessories manufactured or recommended by GE Medical Systems *Information Technologies*. Parts and accessories used shall meet the requirements of EN60601.1.1.

Disposable devices are intended for single use only. They should not be reused.

Periodically, and whenever the integrity of the monitor is in doubt, test all functions.

Refer to the accompanying "Maternal/Fetal Monitoring Operator's Manual" for detailed instructions on fetal monitoring using the modalities available on a 170 Series Monitor.

## Responsibility of the Manufacturer

GE Medical Systems *Information Technologies* is responsible for the effects on safety, reliability, and performance if:

- assembly operations, extensions, readjustments, modifications, or repairs are carried out by persons authorized by GE Medical Systems *Information Technologies*;
- the electrical installation of the relevant room complies with the requirements of appropriate regulations; and
- the monitor is used in accordance with the instructions for use.

## Responsibility of the User

This device is intended for use by clinical professionals who are expected to know the medical procedures, practices, and terminology required to monitor obstetrical patients. This manual documents all possible parameters available in the 170 Series of monitors. It is the responsibility of each hospital to ensure that the Labor and Delivery staff is trained in all aspects of the selected model.

The 170 Series Monitor is designed to assist the perinatal staff by providing information regarding the clinical status of the fetus during labor. The monitor does not replace observation and evaluation of the mother and fetus at regular intervals, by a qualified care provider, who will make diagnoses and decide on treatments or interventions. Visual assessment of the monitor display and strip chart must be combined with knowledge of patient history and risk factors to properly care for the mother and fetus.

# Definitions of Terminology

Six types of special notices are used *throughout* this manual. They are: Danger, Warning, Caution, Contraindication, Important, and Note. (See Table 1-1.) The warnings and cautions in this Safety section relate to the equipment in general and apply to all aspects of fetal monitoring. Be sure to read the safety information in the "Maternal/Fetal Monitoring Operator's Manual" as well as the other chapters in this manual because there are additional warnings and cautions which relate to specific features.

When grouped, warnings and cautions are listed alphabetically and do not imply any order of importance.

**Table 1-1. Definitions of Terminology**

| | |
|---|---|
| **Danger** | A **DANGER** notice indicates an imminently hazardous situation which, if not avoided, will result in death or serious injury. |
| **Warning** | A **WARNING** indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury. |
| **Caution** | A **CAUTION** indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate injury. Cautions are also used to avoid damage to equipment. |
| **Contraindication** | A **CONTRAINDICATION** describes any special symptom or circumstance that renders the use of a remedy or the carrying out of a procedure inadvisable, usually because of a risk. |
| **Important** | An **IMPORTANT** notice indicates an emphasized note. It is something you should be particularly aware of; something not readily apparent. |
| **Note** | A **NOTE** indicates a particular point of information; something on which to focus your attention. |

# Monitor Safety Information

## Warnings

**WARNINGS**

ACCIDENTAL SPILLS—In the event that fluids are accidentally spilled on the monitor, take the monitor out of operation and inspect for damage.

APPLICATION—This monitor is not designed for direct cardiac connection.

CONDUCTIVE CONNECTIONS—Avoid making any conductive connections to applied parts (patient connection) which are likely to degrade safety.

CONDUCTIVE PARTS—Ensure that the conductive parts of the lead electrodes and associated connectors do not contact other conductive parts including earth.

DEFIBRILLATION—During defibrillation, all personnel must avoid contact with the patient and monitor to avoid a dangerous shock hazard. In addition, proper placement of the paddles in relation to the electrodes is required to minimize harm to the patient.

ELECTRICAL SHOCK—To reduce the risk of electrical shock, do not remove the monitor cover. Refer servicing to qualified personnel.

ELECTROMAGNETIC INTERFERENCE—Be aware that strong electromagnetic fields may interfere with monitor operation. Interference prevents the clear reception of signal by the monitor. If the hospital is close to a strong transmitter such as TV, AM, or FM radio, police or fire stations, a HAM radio operator, an airport, or cellular phone, their signals could be picked up as signals by the monitor. If you feel interference is affecting the monitor, contact your Service Representative to check the monitor in your environment.

ELECTROSURGERY—The monitor is not designed for use with high-frequency surgical devices. In addition, measurements may be affected in the presence of strong electromagnetic sources such as electrosurgery equipment.

EXPLOSION HAZARD—Do not use this equipment in the presence of flammable anesthetics or inside an oxygen tent.

**WARNINGS**

GROUNDING—Do not defeat the three-wire grounding feature of the power cord by means of adapters, plug modifications, or other methods. A dangerous shock hazard to both patient and

operator may result.

INSTRUCTIONS—For continued and safe use of this equipment, it is necessary to follow all listed instructions. However, the instructions provided in this manual in no way supersede established medical procedures concerning patient care. The monitor does not replace observation and evaluation of the patient, at regular intervals, by a qualified care provider who will make diagnoses and decide on treatments and interventions.

INTERFACING OTHER EQUIPMENT—Monitoring equipment must be interfaced with other types of medical equipment by qualified biomedical engineering personnel. Be certain to consult manufacturers' specifications to maintain safe operation.

LEAKAGE CURRENT TEST—The interconnection of auxiliary equipment with this device may increase the total leakage current. When interfacing other equipment, a test of leakage current must be performed by qualified biomedical engineering personnel before using with patients. Serious injury or death could result if the leakage current exceeds applicable standards. The use of accessory equipment not complying with the equivalent safety requirements of this equipment may lead to a reduced level of safety of the resulting system. Consideration relating to choice shall include: use of the accessory in the patient vicinity; and evidence that the safety certification of the accessory has been performed in accordance with the appropriate EN60601.1 and/or EN60601.1.1 harmonized national standard.

LINE ISOLATION MONITOR TRANSIENTS—Line isolation monitor transients may resemble actual cardiac waveforms, and thus cause incorrect heart rate determinations and alarm activation (or inhibition).

STRANGULATION—Make sure all patient cables, leadwires, and tubing are positioned away from the patient's head to minimize the risk of accidental strangulation.

WATER BIRTHS—Do not use the monitor to directly monitor patients during water births, in whirlpool or submersion water baths, during showers, or in any other situation where the mother is immersed in water. Doing so may result in electrical shock hazard.

# Cautions

**CAUTIONS**

STATIC SENSITIVITY—This monitor is extremely static sensitive and should be handled using electrostatic discharge precautions.

ANNUAL SERVICING—For continued safety and performance of the monitor, it is recommended that the calibration, accuracy, and electrical safety of the monitor be verified on an annual basis by a GE Medical Systems *Information Technologies* Service Representative.

DAILY TESTING—It is essential that the monitor and accessories be inspected every day. It is recommended practice to ensure the monitor passes its self-test routine—initiated each time the monitor is turned on. Refer to "Monitor Self-Test Routines" on page 4-8.

ENVIRONMENT—The performance of the monitor has not been tested in certain areas, such as x-ray and imaging suites. The monitor is not recommended for use in these environments.

PERFORMANCE—Report all problems experienced with the monitor. If the monitor is not working properly, contact your Service Representative. The monitor should not be used if it is not working properly.

# Electromagnetic Interference

This device has been tested and found to comply with the limits for medical devices to the IEC 601-1-2:1993, EN60601-1-2:2001, Medical Device Directive 93/42/EEC. These limits are designed to provide reasonable protection against harmful interference in a typical medical installation.

However, because of the proliferation of radio-frequency transmitting equipment and other sources of electrical noise in the health-care and home environments (for example, cellular phones, mobile two-way radios, electrical appliances), it is possible that high levels of such interference due to close proximity or strength of a source, may result in disruption of performance of this device.

This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with these instructions, may cause harmful interference with other devices in the vicinity. Disruption or interference may be evidenced by erratic readings, cessation of operation, or incorrect functioning. If this occurs, the site of use should be surveyed to determine the source of this disruption, and actions taken to eliminate the source.

The user is encouraged to try to correct the interference by one or more of the following measures:

- Turn equipment in the vicinity off and on to isolate the offending equipment.
- Reorient or relocate the other receiving device.
- Increase the separation between the interfering equipment and this equipment.
- If assistance is required, contact your GE Service Representative.

# Definitions of Symbols

**NOTE:** Refer to "Controls, Indicators, and Connectors" on page 3-1 for additional information.

The following is a list of symbols used on products manufactured by GE Medical Systems *Information Technologies*. Some symbols may not appear on your unit.

**Table 1-2. Equipment Symbols**

| | |
|---|---|
| | ATTENTION: Consult accompanying documents. |
| | TYPE B EQUIPMENT. Type B equipment is suitable for intentional external and internal application to the patient, excluding direct cardiac application. |
| | TYPE BF EQUIPMENT. Type BF equipment is suitable for intentional external and internal application to the patient, excluding direct cardiac application. Type BF equipment has an F-type applied part. |
| | TYPE CF EQUIPMENT. Type CF equipment is suitable for intentional external and internal application to the patient, including direct cardiac application. Type CF equipment has an F-type applied part. |
|  | ALTERNATING CURRENT (AC). |
| | EQUIPOTENTIALITY. |
| | ON/STANDBY: button toggles between full power and standby. |

**CAUTION**

AC MAINS—The On/Standby switch does not disconnect the monitor from AC mains power. To completely remove power, you must disconnect the power cord from the AC wall outlet.

**For your notes**

# Chapter 2

# Introduction

This section lists the indications for use for monitors in the 170 Series as well as provides an explanation of the different patient monitoring modalities.

This section summarizes the clinical applications of monitors in the 170 Series:


Indications for Use . . . . . 2-2
Risk Conditions . . . . . 2-3
Monitoring Methods. . . . . 2-4

# Indications for Use

## Models 171 and 172

Models 171 and 172 Fetal Monitors are indicated for use: in antepartum testing of fetal well-being, particularly in the high-risk pregnancy; and for routine non-invasive monitoring throughout labor and delivery.

## Models 173 and 174

Models 173 and 174 Fetal Monitors can be used for routine non-invasive and invasive monitoring throughout labor and delivery.

# Risk Conditions

**NOTE:** There may be other factors or conditions that place a patient at risk.

The goal of electronic fetal monitoring for antepartum testing is to differentiate the fetus who is tolerating the intrauterine environment well, from the fetus who may be compromised and require further evaluation or delivery. Some of these conditions are summarized below.

## Maternal Conditions Which Place the Fetus at Risk

The following conditions were summarized from ACOG Technical Bulletin Number 188, "Antepartum Fetal Surveillance," January 1994.

- Postdate pregnancy (42 weeks or more)
- Previous unexplained fetal demise
- Isoimmunization (moderate to severe)
- Hyperthyroidism
- Diabetes mellitus (insulin treated)
- Hypertensive disorders
- Cyanotic heart disease
- Chronic renal disease
- Systemic lupus erythematosus
- Hemoglobinopathies (hemoglobin SS, hemoglobin SC [presence of both hemoglobin S and hemoglobin C], or hemoglobin S-thalassemia)

## Fetal Indications of Potential Fetal Compromise

The following conditions were summarized from ACOG Technical Bulletin Number 188, "Antepartum Fetal Surveillance," January 1994.

- Intrauterine Growth Restriction (IUGR)
- Decrease fetal movement
- Oligohydramnios
- Multiple gestation with significantly discordant growth

# Monitoring Methods

The following is a summary of *all* the clinical monitoring methods found in the 170 Series. Refer to "'Preface, Overview" for information about which modalities apply to your monitor.

## Fetal Heart Rate

### External Method, Pulsed Doppler Ultrasound

Ultrasound monitoring is available on all 170 Series Monitors. Models 171 and 173 provide a single ultrasound channel, while Models 172 and 174 provide two ultrasound channels.

Fetal heart rate can be measured externally using pulsed Doppler Ultrasound. A transducer placed on the mother's abdomen is used to direct an ultrasonic beam toward the fetal heart and to sense Doppler shifted echoes created by moving cardiac structures. A patented autocorrelation process is used to determine the timing of successive cardiac cycles. The resulting fetal heart rate (FHR) pattern is recorded on the strip chart paper and the FHR appears on the digital display.

### Internal Method, Direct Fetal Electrocardiogram (FECG)

FECG is available on Models 173 and 174 only. The Model 173 provides a dedicated FECG connector. The Model 174 provides a combi-connector which can be used for either FECG or US.

FECG signals are obtained via a spiral electrode attached to the fetal presenting part. FHR is computed on a beat-to-beat basis using the R-to-R time interval of the QRS complexes. The instantaneous FHR pattern is printed on the strip chart paper and the FHR appears on the digital display.

## Maternal Uterine Activity

### External Method, Tocotransducer (TOCO)

Maternal uterine activity is measured externally using a tocotransducer (toco). Relative pressure within the uterus is measured using a tocotransducer attached to the mother's abdomen in the area of the uterine fundus. The readings are plotted on the strip chart paper in a relative scale from 0 to 100 as well as shown on the digital display. All 170 Series Monitors provide external uterine activity monitoring.

### Internal Method, Intrauterine Pressure Catheter and Strain Gauge (IUP)

IUP is available on Models 173 and 174 only.

Intrauterine pressure is measured using a transcervical catheter. The pressure trend is plotted over the range of 0 to 100 mmHg and the readings appear on the digital display.

# Chapter 3

# Controls, Indicators, and Connectors

This section describes all possible controls, indicators, and connectors in the 170 Series.

This section contains the following information:


Front Panel Controls . . . . . 3-2
Front Panel Displays and Indicators . . . . . 3-6
Front Panel Connectors . . . . . 3-8
Strip Chart Recorder . . . . . 3-12
Rear Panel Connectors . . . . . 3-14

# Front Panel Controls

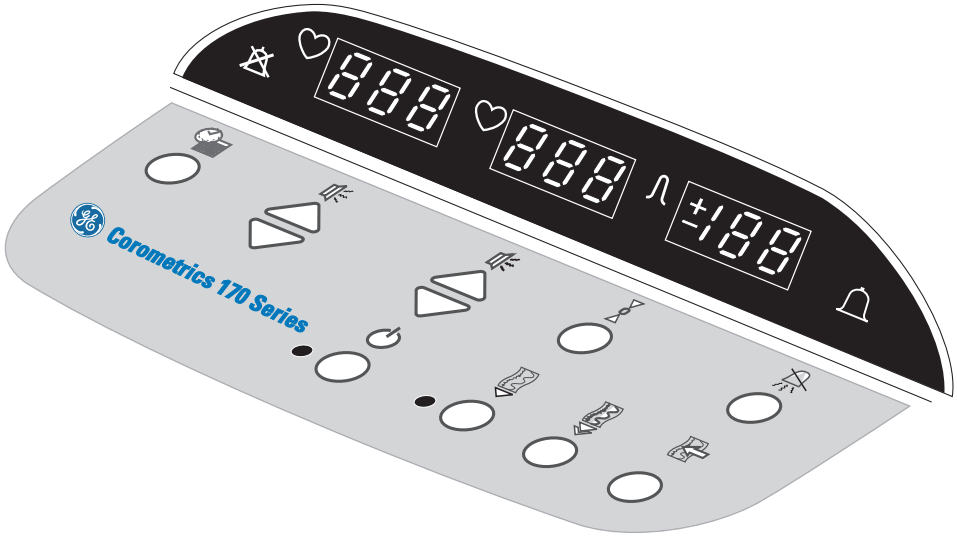



**Figure 3-1. Front Panel Controls (Model 172 shown)**

| Table 3-1. Front Panel Controls | |
|---|---|
| **Symbol** | **Name** |
| | Power |
| | Record |
| | Paper Advance |
| | Mark/Offset |
| | Setup |
| | Volume |
| | UA Reference |
| | Alarm Silence |

## Power Button and Indicator

Pressing the blue Power button turns the monitor on and illuminates the green indicator to the left of the button. Pressing the button again puts the monitor in standby and extinguishes the indicator.

## Record Button and Indicator

Pressing the Record pushbutton activates the recorder, provided paper is installed; the amber indicator illuminates to the left of the button. Pressing the button again turns the recorder off and extinguishes the indicator.

## Paper Advance Button

Pressing the Paper Advance button causes the recorder to advance chart paper at a rate of 40 cm/min for as long as the button is pressed. If the recorder is on, twenty seconds after the button is released, the recorder prints the time, date, active trends legends, and chart speed.

## Mark/Offset Button

The Mark/Offset button is a multifunction button:

### Mark

Briefly pressing the button prints an event mark ↑ on the bottom two lines of the heart rate grid.

### Offset (Models 172, 173, and 174 Only)

When the heart rate offset mode is enabled, pressing and *holding* the Mark/Offset button for at least two seconds shifts the secondary FHR trend +20 BPM for visibility purposes. You will hear a “beep” for confirmation. Refer to “Fetal Heart Rate Offset” on page 5-5 for more information.

# Setup Button

Pressing and holding this button while the monitor is on enters a user setup mode for configuring the monitor. Refer to "Chapter 4, Setup Procedures" for instructions.

Pressing and holding this button during power up enters a service setup mode. Refer to the "170 Series Service Manual" for more information.

# Volume Buttons

The Volume buttons are used to raise (△) and lower (▽) the volume of the audio signals emitted by the speaker. The volume buttons are also used during setup.

## Model 171

This monitor has two volume buttons used to control the ultrasound audio.

## Models 172, 173, and 174

These monitors have four volume buttons. The left pair controls the audio signals for the mode shown in the primary FHR display; likewise, the right pair of buttons controls the audio for the mode shown in the secondary FHR display.

## Setup Mode

When the monitor is in setup mode (user or service), the volume buttons change: the setting or value shown in the FHR display; or the monitor feature code shown in the UA display. (For Models 172, 173, and 174, only the leftmost volume controls are active during setup mode.)

# UA Reference Button

The UA Reference button is used to set the uterine activity pressure reference. This button is also used during setup.

## Setting a Baseline for External Monitoring (Tocotransducer)

Briefly pressing the UA Reference button sets the pressure baseline at a preset default. The monitor is shipped from the factory with a default setting of 10 relative units. Qualified service personnel can access a service screen to set the default to 5, 10, 15, 20, or 25 relative units.

Pressing this button for more than two seconds causes the uterine activity reference value to override the default setting and cycle through all available selections: 5, 10, 15, 20, or 25 relative units, starting at the *default* setting—until the button is released. While the button is held down, the strip chart tracing remains unchanged. Once the button is released, the recorder trace takes on this new value. This value is stored as the new baseline for the currently measured uterine activity signal.

## Setting a Baseline for Internal Monitoring (IUPC)

**NOTE:** IUPC monitoring is only available on Models 173 and 174.

Pressing the UA Reference button sets the pressure baseline at 0 mmHg.

## Setup Mode

When the monitor is in setup mode, the UA Reference button selects the active display. Pressing the button alternates between the UA display (which shows a monitor feature code) and the FHR display (which shows the setting or value for the selected feature code). When the UA display is active, the ± sign lights. When the FHR display is active, the heartbeat indicator ♡ lights.

# Alarm Silence Button

**NOTE:** Silencing an alarm does not affect the visual indications.

This button is yellow for easy recognition. Pressing the Alarm Silence button removes the audible indication of an individual fetal heart rate alarm.

# Front Panel Displays and Indicators

## Fetal Heart Rate Display(s) and Indicator(s)

### FHR Display

A three-digit yellow numeric display indicates the fetal heart rate in beats per minute. The value flashes during an alarm condition.

### Heartbeat Indicator

A yellow heart shaped indicator flashes with each detected valid heartbeat for the fetal heart.

### Primary Versus Secondary (Models 172, 173, and 174 only)

Refer to Table 3-2 for a summary of display positions relative to connectors.

## Uterine Activity Display

This green three-digit display indicates the uterine activity values.

### Tocotransducer

If uterine activity is measured using a tocotransducer, the uterine activity value displays in relative units. A plus sign flashes when the uterine activity value exceeds the strip chart range of 100 relative units.

### IUP (Models 173 and 174 Only)

If uterine activity is measured using a an intrauterine pressure catheter or a strain gauge pressure transducer, the uterine activity value displays in mmHg.

.

**Table 3-2. Display/Connector Summary**

| Monitor | Model 171 | | Model 172 | | | Model 173 | | | Model 174 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Mode** | US | TOCO | US1 | US2 | TOCO | US | FECG | TOCO or IUP | US1 or FECG | US2 | TOCO or IUP |
| **Display** | | | | | | | | | |  |  |
| **Connector** | | | | | | | | | | |  |

# Alarms Disabled Indicator

This yellow indicator illuminates when all alarms have been disabled. The indicator is unlit when alarms are enabled. Refer to "Chapter 4, Setup Procedures" for information on enabling/disabling alarms.

# Audio Alarm Indicator

## Active Patient Alarms

For active patient alarms, this yellow indicator flashes; it continues to flash even if the alarm is silenced.

## Resolved Patient Alarms

For resolved patient alarms, the indicator continues to flash until you silence the alarm. This ensures that the alarm is acknowledged by a clinician.

## Signal Quality Alarms

For signal quality alarms, the indicator flashes during an active alarm and turns off as soon as the condition is resolved. The indicator is unaffected by silencing the audio alarm.

# Front Panel Connectors

## Model 171 Connectors

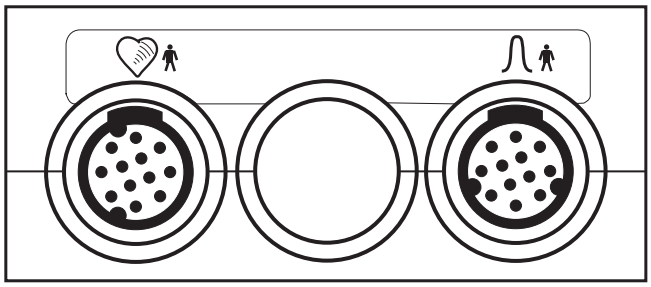


**Figure 3-2. Model 171 Connectors**

### Ultrasound Connector

The ultrasound connector* is a blue, round receptacle mechanically keyed to accept only a Corometrics ultrasound transducer plug. The fetal heart rate derived from this transducer shows in the fetal heart rate display.

### Uterine Activity Connector

The uterine activity connector is a white, round receptacle mechanically keyed to accept a Corometrics tocotransducer. The uterine activity value obtained from this transducer shows in the uterine activity display.

* *If the Model 171 is interfaced to a central information system (CIS), be aware that the CIS may be designed to alarm when there is no fetal heart rate signal. Therefore it is recommended that you unplug the ultrasound transducer from the monitor, when not in use, to eliminate false alarms.*

# Model 172 Connectors

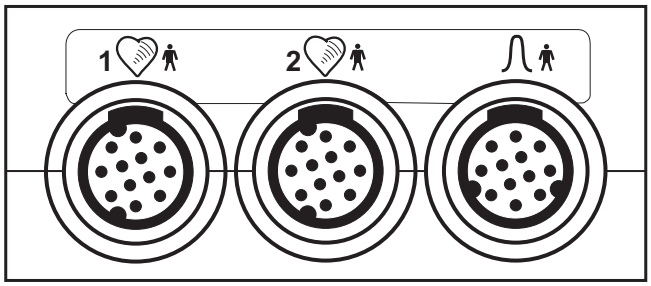



**Figure 3-3. Model 172 Connectors**

## 1 Primary Ultrasound Connector

The primary ultrasound connector* is a blue, round receptacle mechanically keyed to accept only a Corometrics ultrasound transducer plug. The fetal heart rate derived from this transducer shows in the primary fetal heart rate display.

## 2 Secondary Ultrasound Connector

The secondary ultrasound connector* is a blue, round receptacle identical to the primary ultrasound connector described above. The fetal heart rate derived from this connector displays in the secondary fetal heart rate display.

## Uterine Activity Connector

The uterine activity connector is a white, round receptacle mechanically keyed to accept a Corometrics tocotransducer. The uterine activity value obtained from this transducer shows in the uterine activity display.

* *If the Model 172 is interfaced to a central information system (CIS), be aware that the CIS may be designed to alarm when there is no fetal heart rate signal. Therefore it is recommended that you unplug the ultrasound transducer(s) from the monitor, when not in use, to eliminate false alarms.*

# Model 173 Connectors

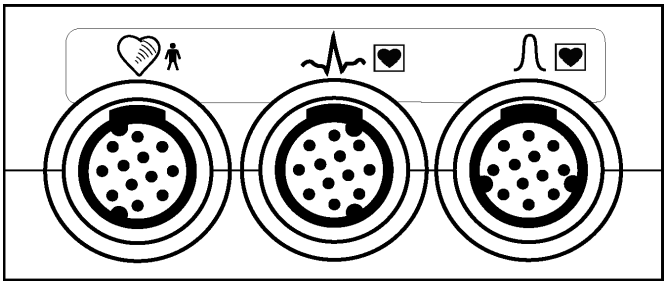


**Figure 3-4. Model 173 Connectors**

## Ultrasound Connector

The ultrasound connector* is a blue, round receptacle mechanically keyed to accept only a Corometrics ultrasound transducer plug. The fetal heart rate derived from this transducer shows in the *primary* fetal heart display.

## FECG Connector

The FECG connector* is a dark grey, round receptacle mechanically keyed to accept a Corometrics FECG cable/legplate plug. The fetal heart rate derived from the spiral electrode displays in the *secondary* fetal heart rate display.

## Uterine Activity Connector

The uterine activity connector is a white, round receptacle mechanically keyed to accept a Corometrics tocotransducer, a Corometrics strain gauge transducer plug, or any intrauterine pressure catheter with compatible cable plug. The uterine activity value obtained from this transducer shows in the uterine activity display.

* *If the Model 173 is interfaced to a central information system (CIS), be aware that the CIS may be designed to alarm when there is no fetal heart rate signal. Therefore it is recommended that you unplug the ultrasound and/or FECG transducers from the monitor, when not in use, to eliminate false alarms.*

# Model 174 Connectors

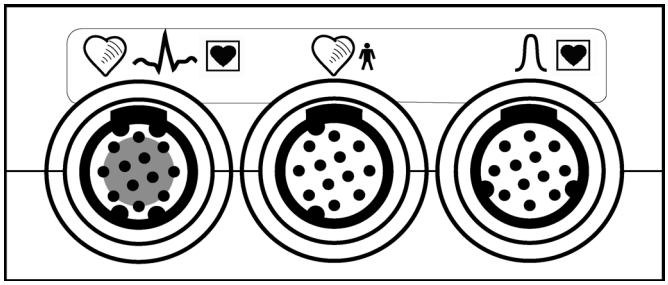


**Figure 3-5. Model 174 Connectors**

## Combi-Connector (Primary Ultrasound or FECG)

The combi-connector is a blue connector* with a dark grey inner center. This round receptacle is mechanically keyed to accept only a Corometrics ultrasound transducer plug or a Corometrics FECG cable/legplate plug. The fetal heart rate derived from this transducer or cable/legplate shows in the *primary* fetal heart display.

**IMPORTANT**

COMBI-CONNECTOR—The combi-connector can be used for monitoring ultrasound *or* FECG depending on what you plug in (US transducer or FECG cable/legplate). When used in conjunction with the secondary ultrasound connector, you have the option of monitoring twins using dual US or FECG/US.

## Secondary Ultrasound Connector

The secondary ultrasound connector* is a blue, round receptacle mechanically keyed to accept only a Corometrics ultrasound transducer plug. The fetal heart rate derived from this connector shows in the *secondary* fetal heart rate display.

## Uterine Activity Connector

The uterine activity connector is a white, round receptacle mechanically keyed to accept a Corometrics tocotransducer, a Corometrics strain gauge transducer plug, or any intrauterine pressure catheter with compatible cable plug. The uterine activity value obtained from this transducer shows in the uterine activity display.

* *If the Model 174 is interfaced to a central information system (CIS), be aware that the CIS may be designed to alarm when there is no fetal heart rate signal. Therefore it is recommended that you unplug the ultrasound and/or FECG transducers from the monitor, when not in use, to eliminate false alarms.*

# Strip Chart Recorder

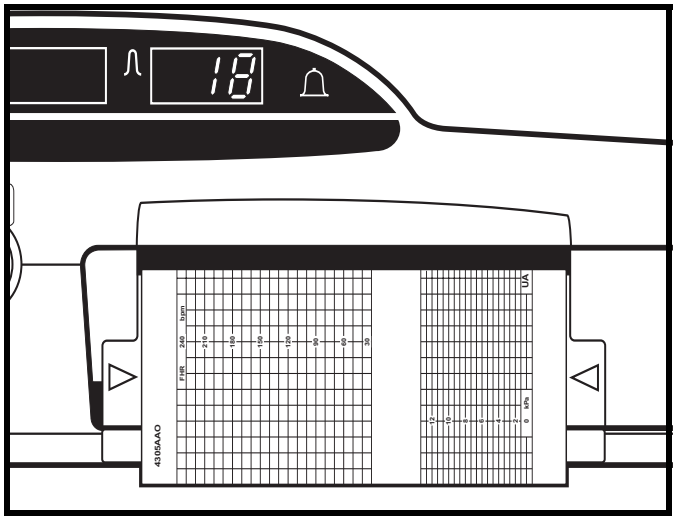



**Figure 3-6. Strip Chart Recorder**

The strip chart recorder is located on the right side of the front panel. Latches on each side of the recorder open the paper drawer.

Two styles of paper are available: 30-240 BPM scale and 50-210 BPM scale.

Refer to "Chapter 4, Setup Procedures" for instructions on loading strip chart paper into the recorder.

## Heart Rate Grid

One or two fetal heart rate trends print in the top (or left) grid of the strip chart paper—depending on your model monitor and the active modalities.

If only one fetal heart rate is being monitored, the FHR trend is printed in black. If twins are being monitored, the primary trend is printed in plain black while the secondary trend is bolded.

Read "Chapter 5, Fetal Heart Rate Monitoring" and "Chapter 7, Strip Chart Recorder" for additional information about fetal heart rate trends and annotations.

## Uterine Activity Grid

The uterine activity trend prints in black on the bottom (or right) grid of the strip chart paper.

Read "Chapter 6, Uterine Activity Monitoring" and "Chapter 7, Strip Chart Recorder" for more information about uterine activity trends and annotations.

## Annotation Area

An annotation area is provided between the fetal heart rate and uterine activity grids. Refer to "Chapter 7, Strip Chart Recorder" for detailed information.

# Rear Panel Connectors

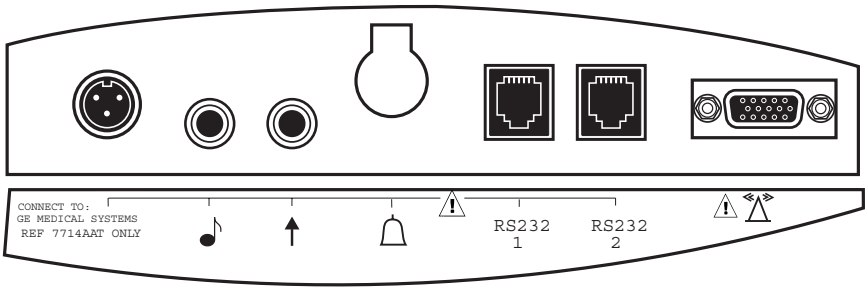



**Figure 3-7. Rear Panel Connectors**

## Power Supply Connector

This is the receptacle for the AC adapter, P/N 7714AAT only. A line cord connects from the other end of the adapter to an AC wall outlet. The connector is labeled **CONNECT TO GE MEDICAL SYSTEMS REF 7714AAT ONLY**. The power supply is a universal AC-to-DC converter which can accept an AC input in the range 100–230 VAC. The converter supplies a regulated 12 Vdc to the monitor.

## ♪ Remote Mark Connector

This connector is provided for attaching an optional Corometrics Model 146 Fetal Acoustic Stimulator (FAST). The annotation ♪ prints on the strip chart each time the Model 146 is used.

## ↑ Remote Mark Connector

This connector is provided for attaching an optional Corometrics Remote Event Marker. This accessory annotates the strip chart recorder paper with a marker which can be configured as one of the following:

↑ : This annotation is commonly used to record an “event.”

FM↑ : This annotation is commonly used as an indication that the mother has perceived fetal movement.

The monitor is factory set to use the FM↑ annotation. Refer to the “170 Series Service Manual” for information about selecting the annotation.

## Nurse Call Interface

This connector is intended for future interfacing to a standard Nurse Call System.

# RS-232C Connectors

Two RS-232C connectors are provided for interfacing to peripheral equipment such as:

- a maternal non-invasive blood pressure monitor
- a Nellcor Model N-400 Fetal Oxygen Saturation Monitor
- a central information system that uses Hewlett-Packard's Digital Series Interface Protocol

Contact your Service Representative for more information.

**CAUTION**
NON-DESTRUCTIVE VOLTAGE—The maximum non-destructive voltage that may be applied to the rear panel connectors is 0 V. Do not attempt to connect cables to these connectors without contacting your Biomedical Engineering Department or Service Representative. This is to ensure the connectors comply with leakage-current requirements of one of the following applicable standards: Underwriters Laboratories UL-2601.1, Canadian Standards Associations CSA 22.2 No. 125, or International Electrotechnical Commission EN60601.1.

# Telemetry Connector

This high-density 15-pin connector is intended for future interfacing to the receiver of a Corometrics telemetry system. Contact your Service Representative for more information.

**IMPORTANT**
TELEMETRY—For proper operation when using a telemetry system, disconnect all transducers from the front panel of the 170 Series Monitor. Refer to the operator's manual for your telemetry system for more information.

**For your notes**

# Chapter 4

# Setup Procedures

This section contains information about configuring a 170 Series Monitor to meet the individual needs of your clinic or hospital. Use of the monitor will vary according to the accessories attached to it, the clinical applications in which it is used, and the personal preferences of the users.

This chapter lists all available user setup options in the monitor and provides step-by-step instructions for making selections:


Loading Strip Chart Paper . . . . . 4-2
Turning the Monitor On . . . . . 4-7
Turning the Monitor On . . . . . 4-7
Recorder Test . . . . . 4-9
Mounting the Strain Gauge for IUP Monitoring . . . . . 4-14
Preparing the Monitor for Patient Use . . . . . 4-15

# Loading Strip Chart Paper

The ***required*** paper for use with the 170 Series Monitor is:

- catalog number (REF) 4305AAO/CAO (HR scale of 30–240 BPM); or
- catalog number (REF) 4305BAO/DAO (HR scale of 50–210 BPM).

Refer to "Chapter 7, Strip Chart Recorder" for more information about the different paper styles.

**CAUTIONS**

LOADING PAPER—The instructions for loading paper into a 120 or 170 Series Monitor *are different* than the instructions for loading paper into other Corometrics monitors with which you may be familiar. Improper loading can cause paper jams. Follow the instructions carefully.

PAPER TYPE—Do not use *non*-Corometrics paper or paper designed for use with *other* Corometrics monitors. Using paper other than catalog number (REF) 4305AAO/BAO/CAO/DAO: may produce inferior print quality; could result in permanent damage to the recorder's print head; and may void your warranty.

STORAGE/TRANSPORT—Paper should be installed in the monitor's strip chart recorder at *all* times. This reduces particle build up on the printhead and facilitates opening the recorder door.

To protect against paper jams, the 170 Series recorder contains a paper-loading sensor which detects if the paper has been incorrectly loaded. When the recorder detects a paper-load–error condition:

- the recorder will not print;
- the **Record** indicator flashes on and off every second; and
- three short beeps (low tones) sound every three seconds at a fixed volume.

The most likely cause of a paper-load–error condition is that you loaded the paper with the black squares facing up. The correct method is to load the paper with the black squares down, as explained later in this section.

To install Corometrics catalog number (REF) 4305AAO/BAO/CAO/DAO chart paper in the 170 Series Monitor, follow these steps:

**CAUTION**
LOADING PAPER—Paper loading instructions for a 170 or 120 Series Monitor *are different* than other Corometrics monitors with which you may be familiar.

1. Press on each side of the paper drawer to release the drawer latches.

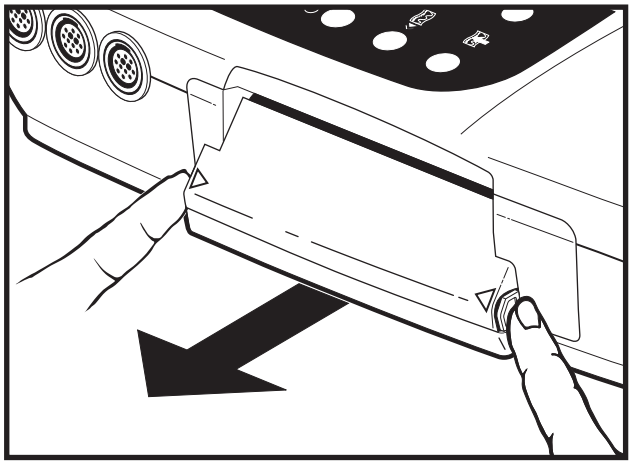


**Figure 4-1. Releasing the Drawer Latches**

2. Slide the paper drawer out toward you.

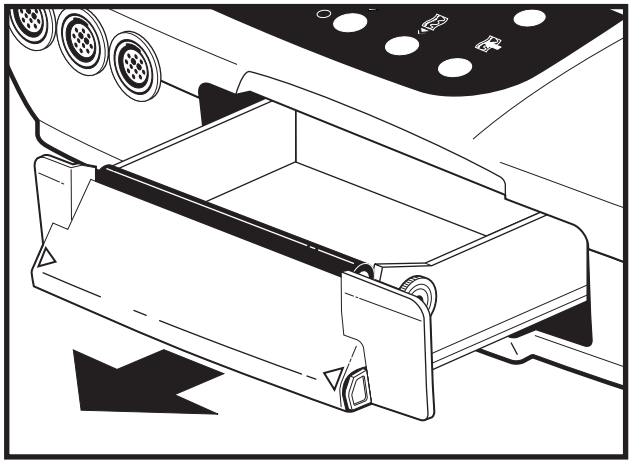


**Figure 4-2. Opening the Paper Drawer**

3. Remove the plastic wrapper from the paper and discard.

4. Fan the pack of Z-fold paper on all sides to loosen any folds and to ensure proper feed of the paper throughout the recorder.

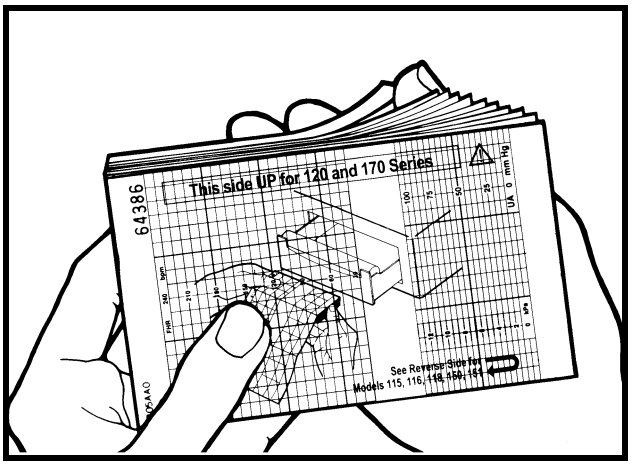



**Figure 4-3. Fanning the Paper**

**NOTE:** The black squares indicate the end of the recorder paper. When the black squares appear, the strip chart recorder has approximately 20 minutes of paper remaining, when running at a speed of 3 cm/min.

5. Hold the package of paper so that:

   - the black squares are on the ***bottom*** of the pack; and
   - the GE Medical Systems *Information Technologies* name and page numbers are on the ***left*** side of the pack.

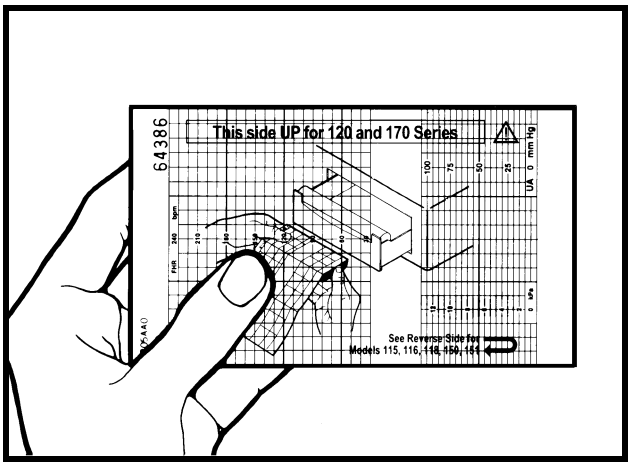



**Figure 4-4. Orienting the Paper**

6. Unfold two sheets from the ***top*** of the pack so that they extend toward you.

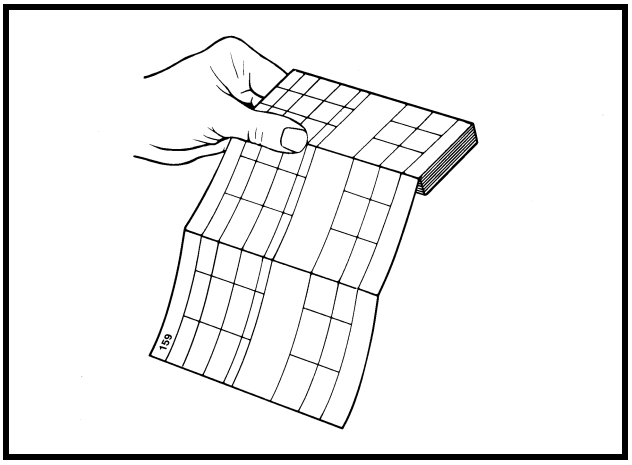


**Figure 4-5. Creating a Paper Leader**

7. Place the pack in the drawer so that the pack is laying *flat* in the bottom of the paper tray.

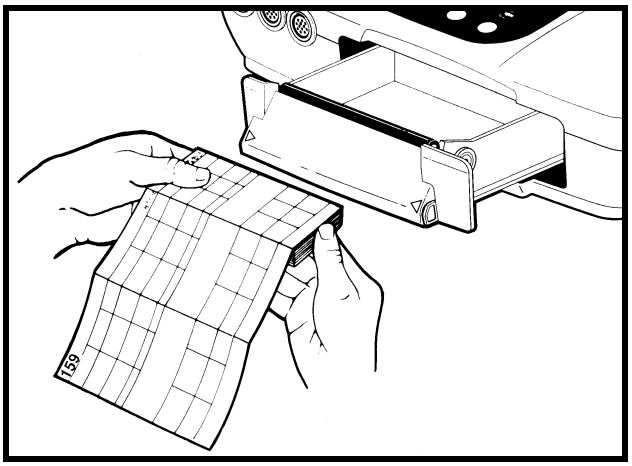


**Figure 4-6. Inserting the Paper**

8. Pull the paper leader taut at an angle between remaining pack and the paper guides. The balance of the paper pack should stay flat in the drawer as shown in Figure 4-7. (The paper guides are shown in Figure 4-8.)

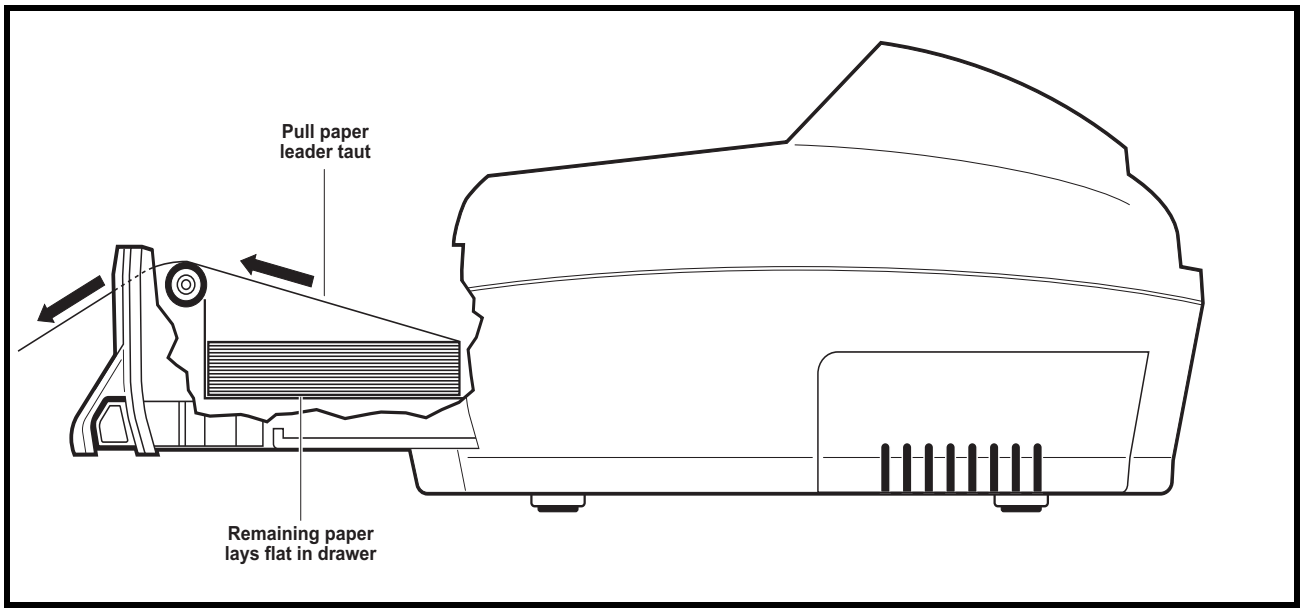



**Figure 4-7. Paper Drawer Side Cutaway View**

9. Slide the drawer closed by exerting even pressure on both sides of the drawer. Avoid skewing the drawer in its tracks. (The pre-printed vertical lines on the paper should be parallel to the printhead.) You will hear a click when the drawer is locked in place.

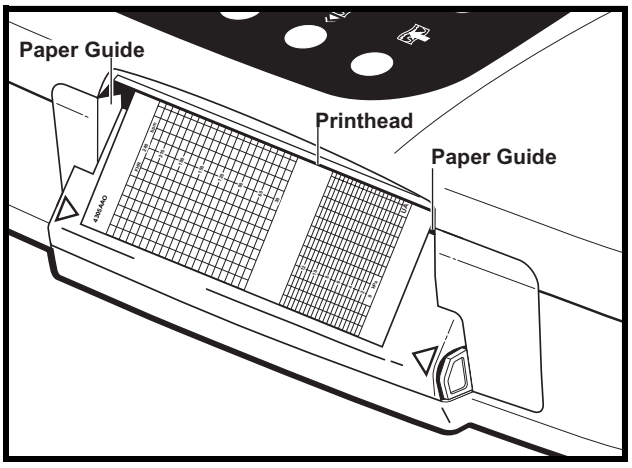



**Figure 4-8. Closing the Paper Drawer**

**IMPORTANT**

PAPER—Paper should *always* be installed in the monitor. The monitor runs a self-test routine each time it is powered on; part of this routine includes a recorder test.

# Turning the Monitor On

The 170 Series uses a universal AC-to-DC converter which accepts an AC input in the range 100–230 VAC. The converter supplies a regulated 12 Vdc to the 170 Series Monitor.

1. Connect the AC adapter into the power supply connector labeled: **CONNECT TO GE MEDICAL SYSTEMS REF 7714AAT ONLY**.

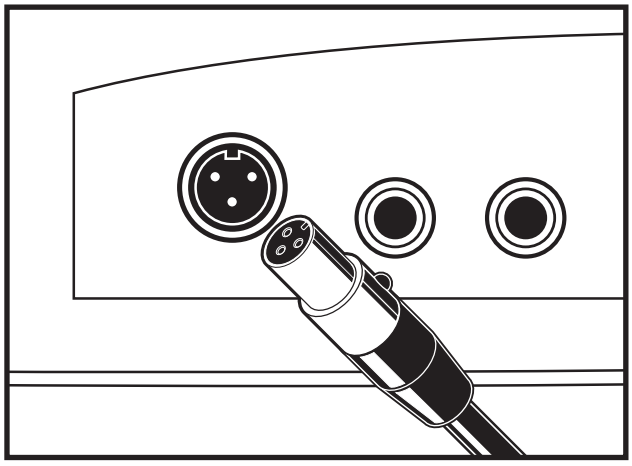


**Figure 4-9. Connecting the AC Adapter**

2. Connect one end of the detachable line cord to the AC adapter; connect the other end into a hospital grade grounded wall outlet.
3. Press the monitor's **Power** button ⏻. The green indicator next to the button illuminates. A self-test routine automatically runs. Read "Monitor Self-Test Routines" on the next page.

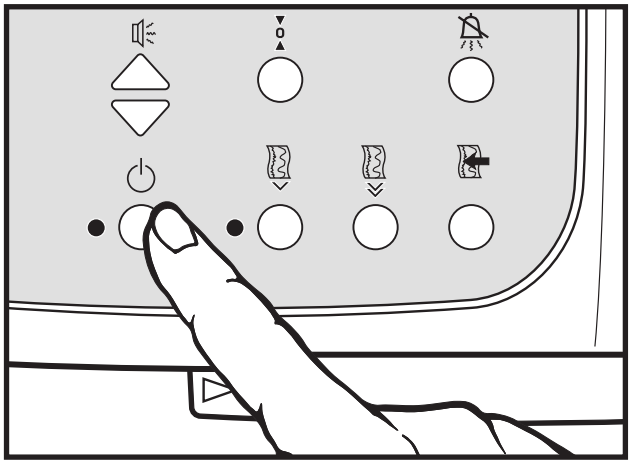


**Figure 4-10. Turning the Monitor On**

# Monitor Self-Test Routines

**NOTE:** Ensure paper is installed in the recorder in order to verify a successful recorder test.

Each 170 Series Monitor contains a self-test routine which checks the internal circuitry of the monitor, the displays and indicators, and the strip chart recorder. The self-test routine is automatically initiated each time you turn on the monitor.

**CAUTION**
SELF-TEST FAILURE—If there is any problem with the self-test routine, turn off the monitor and remove it from operation. Notify your Biomedical Engineering Department or Service Representative.

**NOTE:** If the recorder was off at the time the monitor was turned off, the test routine will turn the recorder on, then turn it off after the tests are complete. If the recorder was on at the time the monitor was turned off, the tests will be performed and the recorder will remain on.

After completion of a successful self-test routine, the monitor is ready for use.

**Table 4-1. Summary of Self-Test Routines**

| Test Description | What to Verify |
|---|---|
| **Display/Indicator Test:** All displays and indicators illuminate. | Ensure all indicators and each segment of the displays illuminate throughout the entire self-test routine. |
| **Internal Test:** The internal circuitry of the monitor is verified. | Make sure the monitor performs the recorder test. If there is a problem with the internal circuitry, the recorder test will not be performed. |
| **Recorder Test:** The following message prints on the strip chart paper: TEST: ARE ALL DOTS PRINTED? Three continuous lines are drawn across the strip chart recorder paper, testing the integrity of the printhead. See Figure -. | Ensure that the lines are printed in the correct positions on the paper. Verify that the lines are continuous and no gaps appear on the traces. |

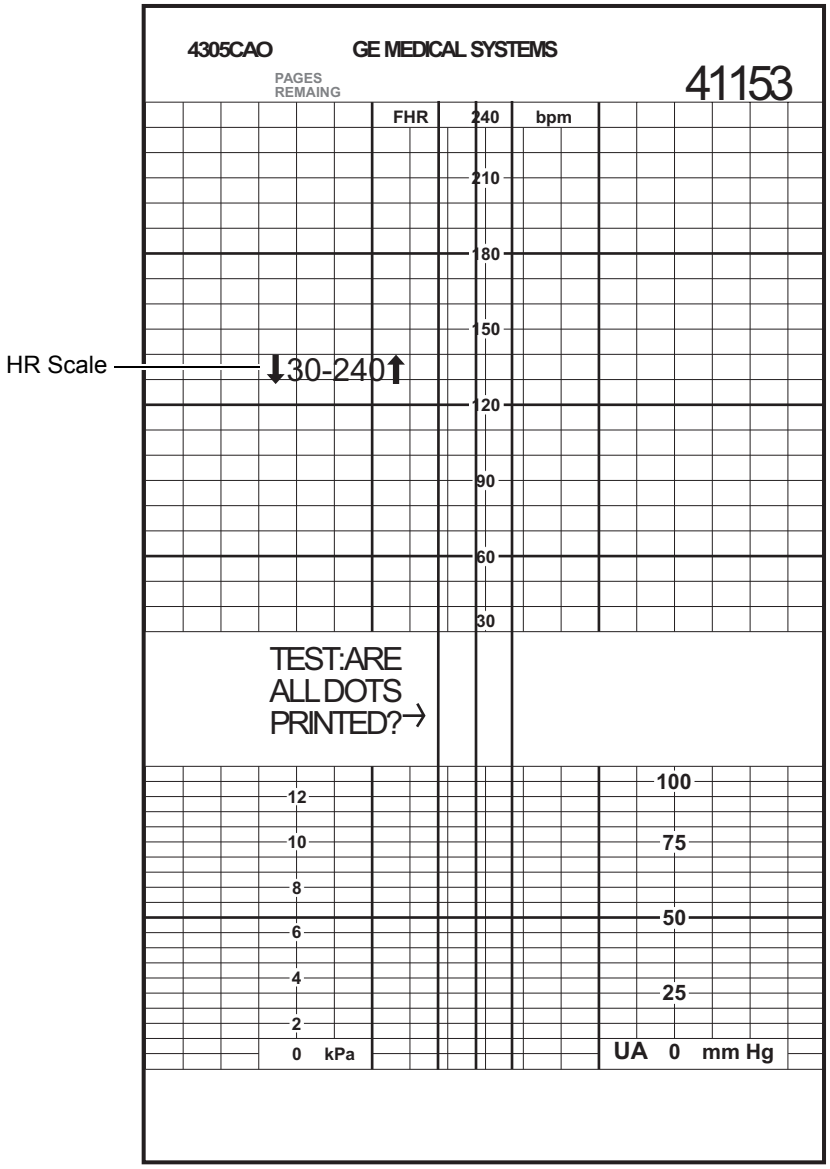
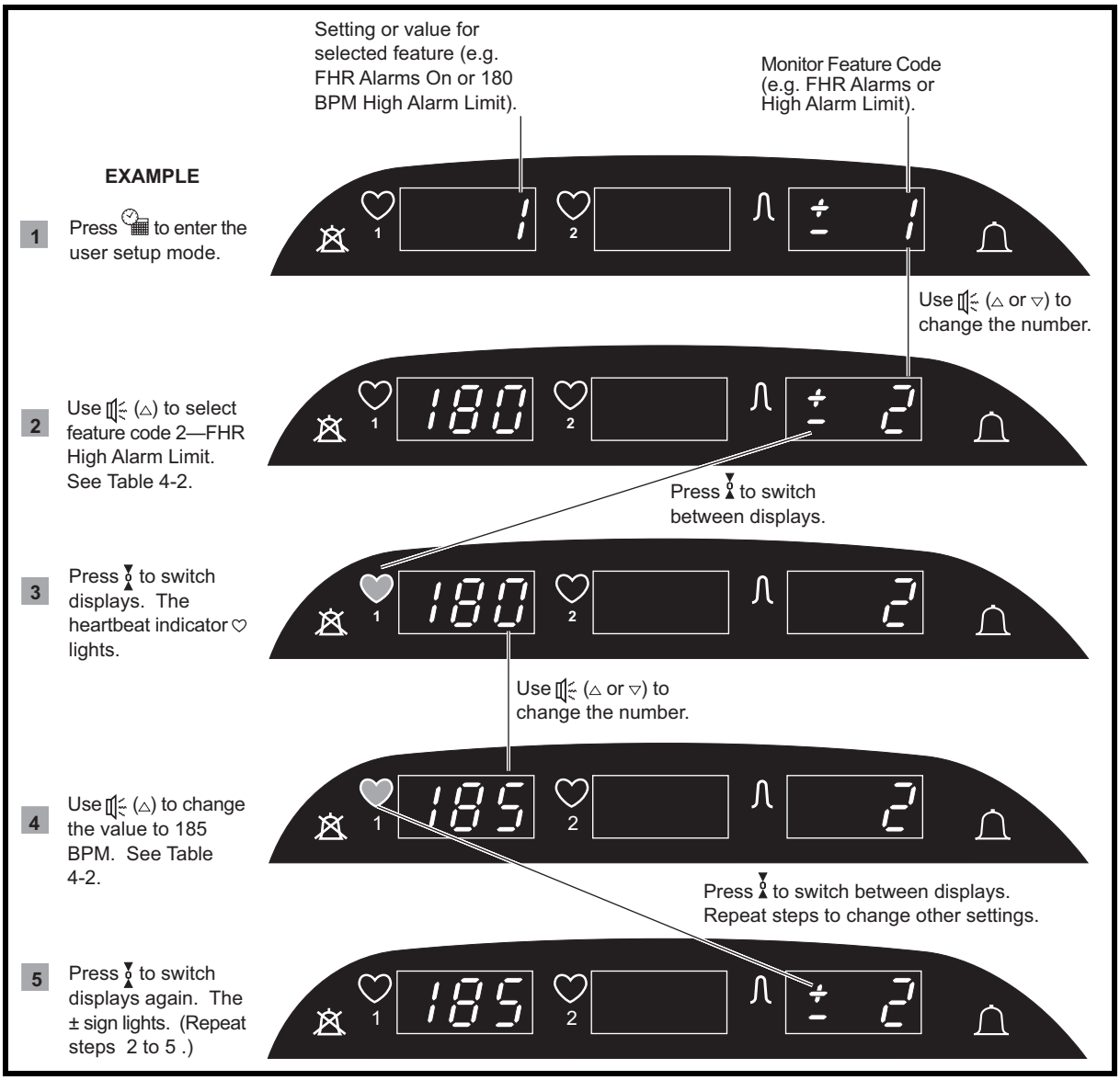



**Figure 4-11. Recorder Test**

# Customizing the Monitor

The monitor includes a user setup mode where you can:

- enable/disable alarm functionality
- set the high alarm limit for the fetal heart rate
- set the low alarm limit for the fetal heart rate
- set the alarm volume
- set the time and date
  (A 170 Series Monitor is Year 2000 compliant.)


Setting or value for selected feature (e.g. FHR Alarms On or 180 BPM High Alarm Limit).
Monitor Feature Code (e.g. FHR Alarms or High Alarm Limit).
EXAMPLE
1
Press to enter the user setup mode.
Use (△ or ▽) to change the number.
2
Use (△) to select feature code 2—FHR High Alarm Limit. See Table 4-2.
Press to switch between displays.
3
Press to switch displays. The heartbeat indicator ♡ lights.
Use (△ or ▽) to change the number.
4
Use (△) to change the value to 185 BPM. See Table 4-2.
Press to switch between displays. Repeat steps to change other settings.
5
Press to switch displays again. The ± sign lights. (Repeat steps 2 to 5 .)

**NOTE:** For Models 172, 173, and 174, use the leftmost set of volume controls.

**Figure 4-12. Setup Mode Summary (Model 172 shown)**

**NOTE:** If an alarm occurs while in user setup mode, the heart rate display will not flash; however, the alarm indicator flashes and the audio alarm sounds. As soon as you exit the setup mode, the affected display flashes to indicate the alarm condition.

You can enter the user setup mode during a monitoring session. The fetal heart rate and uterine activity trends print without interruption; however you will be unable to see the heart rate and uterine activity values on the display while in the user setup mode.

1. Press the monitor's **Power** button to turn on the monitor. Wait until the monitor completes the self-test routine and enters the normal operating mode.
2. Press and hold the **Setup** button, for a few seconds, to enter the user setup mode.
3. Use the **UA Reference** button to toggle between the setup code (shown in the UA display) and the setting or value (shown in the primary FHR display). The UA display is active when the ± qualifier illuminates; the FHR display is active when the heartbeat indicator illuminates.
4. Use the **Volume** buttons to increase ( △ ) or decrease ( ▽ ) the code, value, or setting shown in the active display. Refer to Table 4-2. (For Models 172 and 173, use the leftmost set of volume controls.)
5. Repeat steps 3 and 4 until all settings are configured.
6. Press the **Setup** button to exit the user setup mode and return to monitoring. New settings take effect at this point.

**NOTE:** If an alarm is in progress when you exit the user setup mode, any changes to an alarm setting do not take effect until the alarm condition is resolved.

Table 4-2 lists the available settings for the user setup mode. Table 4-3 provides a summary of the factory default settings for both the user and service setup options.

| Table 4-2. Summary of User Setup Codes | | |
|---|---|---|
| **Code (UA Display)** | | **Setting or Value (Primary FHR Display)** |
| **Code** | **Description** | |
| 1 | FHR Alarms | 0 = off (disabled)<br>1 = on (enabled) |
| 2 | FHR High Alarm Limit | 140–210 (BPM, in increments of 5 BPM) |
| 3 | FHR Low Alarm Limit | 50–140 (BPM, in increments of 5 BPM) |
| 4 | FHR Alarm Volume | 2–10 |
| 10 | Minutes (time setting) | 0–59 (minutes) |
| 11 | Hours (time setting) | 0–23 (hours) |
| 12 | Day of Month (date setting) | 1–31 (day) |
| 13 | Month (date setting) | 1–12 (month) |
| 14 | Year (date setting) | 00–99 (year) |

| Table 4-3. Summary of Factory Defaults | | |
|---|---|---|
| **Setup Option** | **Factory Default** | **Hospital/Clinic Setting** |
| FHR Alarms | on | |
| FHR High Alarm Limit | 160 BPM | |
| FHR Low Alarm Limit | 120 BPM | |
| FHR Alarm Volume | 5 | |
| Time/Date | Eastern Standard Time or Daylight-Saving Time—whichever is applicable | |
| *ECG Artifact Elimination (Models 173 and 174 only) | off | |
| *Heartbeat Coincidence (Models 172, 173, and 174 only) | off | |
| *Fetal Movement Detection **(if purchased and installed)** | on | |
| *Language | set according to shipping destination | |
| *Recorder Speed | United States: 3 cm/min<br>International: 1 cm/min | |
| *Paper Scale | United States: 30–240 BPM<br>International: 50–210 BPM | |
| *RS-232 Port 1 Communications Mode | HP | |
| *RS-232 Port 1 Baud Rate | 1200 | |
| *RS-232 Port 2 Communications Mode | ext. BP | |
| *RS-232 Port 2 Baud Rate | 600 | |
| *Remote Mark Annotation | on ( FM ) | |
| *HR Offset (Models 172, 173, and 174 only) | on with 10-minute auto-revert | |
| *UA Reference | 10 relative units | |

* = service setup mode

# Mounting the Strain Gauge for IUP Monitoring

IUP monitoring is an intrapartum monitoring method available on Models 173 and 174 Fetal Monitors only.

There is no provision for mounting the strain gauge directly on the monitor. It is recommended that you use a standard IV (intravenous) pole and mount it according to your hospital protocol.

# Preparing the Monitor for Patient Use

The following steps should be performed prior to each patient monitoring session:

1. Ensure an adequate supply of paper is in the recorder. The recorder automatically stops when paper runs out. If the recorder requires paper, refer to "Loading Strip Chart Paper" on page 4-2.
2. Press the **Power** button and wait for the monitor to complete the self-test routine. Refer to "Monitor Self-Test Routines" on page 4-8. Ensure the monitor enters the normal operating mode.

**NOTE:** Refer to "Customizing the Monitor" on page 4-10 if you need to change an alarm or time/date setting.

3. Check the status of the monitor's alarms disabled indicator. When lit the alarms are disabled.
4. If the alarms are *enabled*, check the strip chart printout and acknowledge the settings for the high and low alarm limits for the fetal heart rate.
5. Check the time and date that is printed on the strip chart paper.
6. Attach the appropriate transducer(s) for monitoring. Read the "Maternal/Fetal Monitoring Operator's Manual" for instructions on applying the transducers.
7. Press the **Record** button and ensure that the chart paper moves freely out the front of the recorder drawer.

**For your notes**

# Chapter 5

# Fetal Heart Rate Monitoring

This section provides a brief overview of fetal heart rate monitoring using a 170 Series Fetal Monitor. Refer to the "Maternal/Fetal Monitoring Operator's Manual" for additional information.

The 170 Series offers the following:

- 171: singleton ultrasound
- 172: dual ultrasound
- 173: ultrasound and FECG
- 174: FECG/ultrasound or dual ultrasound

This section summarizes the fetal heart rate monitoring methods available in the 170 Series, as well as the heart rate offset, heartbeat coincidence, and heart rate alarm features:


Ultrasound (External Method) . . . . . 5-2
Simulated Fetal Movement Detection Trace . . . . . 5-3
Fetal Heart Rate Offset. . . . . 5-5
Heartbeat Coincidence . . . . . 5-7
Fetal Heart Rate Alarms. . . . . 5-9

# Ultrasound (External Method)

## Methodology

An ultrasound transducer placed on the maternal abdomen is used to direct an ultrasonic beam toward the fetal heart; the transducer detects Doppler shifted frequency changes in echoes created by moving cardiac structures. An autocorrelation process is used to determine the time interval between successive cardiac cycles.

The fetal heart rate is displayed in BPM and continuously plotted on the strip chart recorder paper.

GE Medical Systems *Information Technologies* offers two styles of ultrasound transducers: loop-style and button-style. Both styles are discussed in the "Maternal/Fetal Monitoring Operator's Manual".

## Fetal Movement Detection

**NOTE:** The fetal movement detection option is associated with the primary ultrasound connector only. For Models 172 and 174 (dual ultrasound), FMD is *not* available for the secondary ultrasound connector.

Fetal movement detection (FMD) is an option which can be installed in your monitor to function with the ultrasound channel. Contact your Service Representative for information about purchasing this option.

### Methodology

Fetal movement detection is designed to detect gross fetal body movements and body movements with associated limb movement. GE Medical Systems *Information Technologies* defines "gross fetal body movement" as the "extension, flexion, or rolling over of the fetal trunk about the longitudinal axis of the body and associated limb movements." Movements of the extremities alone *may not* be detected. Eye movements *will not* be detected.

**CAUTION**
FALSE DETECTION—The following may be automatically detected as fetal movement: transducer movement and maternal movement such as coughing, laughing, repositioning, mother poking her abdomen, in addition to emesis, fetal hiccups, or twins. During fetal sleep, or in the event of a fetal demise, some of these detected movements may be confused with fetal movement.

### Enabling/Disabling Fetal Movement Detection

Fetal movement detection is enabled/disabled from a service setup mode. Refer to the "170 Series Service Manual" for more information.

## Strip Chart Annotations

When fetal movement detection is *enabled*, the mode annotation **FMD - —** is printed on the center margin. The annotation only provides an indication that the feature is enabled—it does not indicate detection.

When fetal movement is *detected*, a solid line is automatically marked on the bottom of the heart rate grid for the duration of the detected movement. (Refer to Figure 5-1.)

## Using the Remote Event Marker to Complement the Patient Record

The Remote Event Marker is an accessory that can be used to complement the patient record. The annotation resulting from the Remote Event Marker can be configured as one of the following:

- ↑: commonly used to record a general event; or
- FM ↑: commonly used as an indication that the mother has perceived fetal movement. (This is the factory default setting.)

Instruct the mother to press the button on the Remote Event Marker whenever she feels fetal movement. Ask her to hold down the button for the duration of the perceived fetal movement. The annotation, ↑ or FM ↑, is printed on the strip chart in addition to a horizontal bar for as long as the Remote Event Marker button is held down. (Refer to Figure 5-1.)

**Figure 5-1. Simulated Fetal Movement Detection Trace**

# FECG (Internal Method)

## Methodology

This method uses an electrode attached directly to the fetal presenting part. The electrode is connected to the cable/legplate secured to the mother. The fetal heart rate is computed based upon the interval between successive R-wave peaks of the fetal QRS complex.

The fetal heart rate is displayed in BPM and continuously plotted on the strip chart recorder paper.

## Artifact Elimination

**NOTE:** This feature only affects direct FECG monitoring. Ultrasound monitoring is unaffected by this setting.

An ECG artifact elimination feature is available on Models 173 and 174.

### Enabling/Disabling Artifact Elimination

This feature is enabled/disabled via a service setup mode. (The factory default setting is *off*.) Refer to the "170 Series Service Manual" for more information.

### Theory and Methodology

When ECG artifact elimination is turned *on*, the monitor will not print any new FHR value which differs by more than ±25 BPM from the previously calculated heart rate value. The printing inhibition functions on a beat-to-beat basis by comparing the last calculated rate against the newly calculated rate. The rate used for comparison purposes is always the previous rate regardless of whether this rate passed the previous ±25 BPM test. When ECG artifact elimination is turned *off*, all direct ECG rates are plotted by the recorder without regard to their deviation from previous rates. The effect of this function change is that sudden heart rate changes (such as certain arrhythmias, accelerations, or decelerations) as well as artifactual changes (as when the electrode is disturbed or loosely connected) are not recorded when ECG artifact elimination is turned *on*; instead gaps in the tracing occur.

# Fetal Heart Rate Offset

The Model 172 monitors twins using dual ultrasound. The Model 173 (with only one ultrasound channel) monitors twins using FECG and ultrasound. The Model 174 (with a combi-connector) can monitor twins using FECG/ultrasound or dual ultrasound. When monitoring twins, overlapping fetal heart rate traces may be difficult to interpret. Models 172, 173, and 174 provide a +20 BPM shift for the secondary FHR trend to alleviate this problem.

## Enabling/Disabling the Fetal Heart Rate Offset Mode

The fetal heart rate offset mode can be enabled/disabled from a service setup mode. Refer to the "170 Series Service Manual" for more information.

**NOTE:** *Enabled* and *active* do not mean the same thing. When the option is enabled via the service mode, you then have the capability to *activate* and *de-activate* the function as needed.

The fetal heart rate offset mode has three settings:

- disabled: users cannot activate the function.
- enabled/on: users can activate/de-activate the function.
- enabled/auto-revert: users can activate/de-activate the function; in addition, the shifted trend automatically returns to the unshifted position after ten minutes.

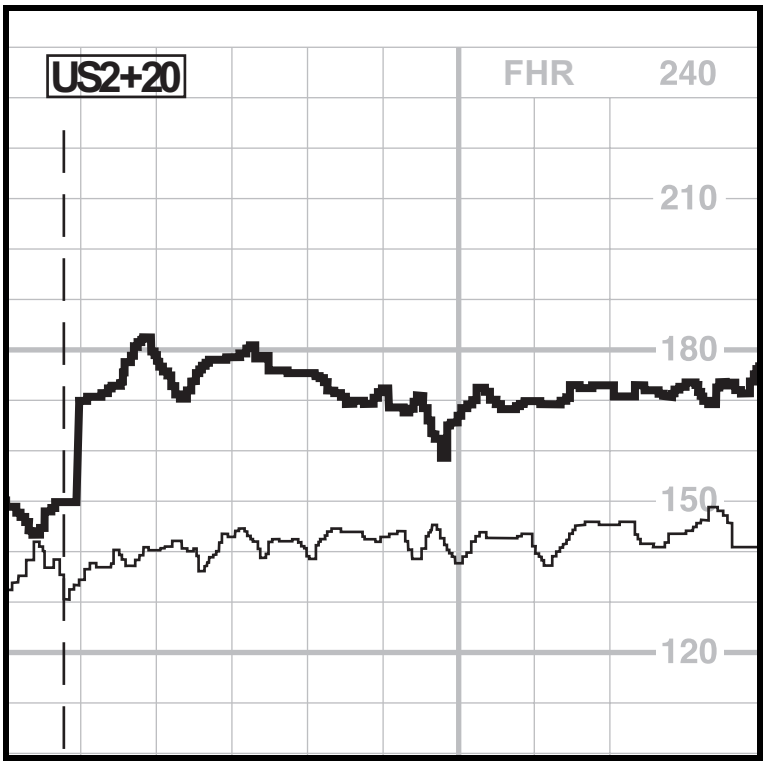



**Figure 5-2. Fetal Heart Rate Offset Example (Model 172 shown)**

# Activating the Fetal Heart Rate Offset Mode

When you activate the heart rate offset mode, the *secondary* FHR trend is shifted +20 BPM. (See Figure 5-2.)

1. Ensure the recorder is *on*.
2. Press and hold the **Mark/Offset** button for *two seconds*. You will hear a "beep" for confirmation.

   - On a Model 172 or 174 (dual ultrasound), the secondary ultrasound trace is shifted +20 BPM and the **US2+20** symbol is printed on the upper portion of the heart rate grid every page.
   - On a Model 173 or 174 (US/FECG), the ultrasound trace is shifted +20 BPM and the **US + 20** symbol is printed on the heart rate grid every page.
   - Upon activation, a vertical dashed line is printed to draw attention to the start of the shifted trend.

# De-Activating the Fetal Heart Rate Offset Mode

After the FHR patterns have been assessed, set the secondary FHR trend back to the normal (unshifted) position.

1. Ensure the recorder is *on*.
2. Press and hold the **Mark/Offset** button for *two seconds*. You will hear a "beep" for confirmation.

   - The trend returns to the unshifted position.
   - A vertical dashed line is printed to draw attention to the change.

**NOTE:** If the auto-revert (10-MIN) feature is enabled, the shifted heart rate trace automatically reverts to normal after 10 minutes. (Refer to the "170 Series Service Manual" for more information.)

# Heartbeat Coincidence

Heartbeat coincidence is available on Models 172, 173, and 174 (dual heart rate monitors) to alert you when you may be monitoring a duplicate signal. Heartbeat coincidence is indicated when two heartbeats have a consistent phase relationship for equal to or greater than 60% of the detected beats for about 60 seconds; the cessation of coincidence is indicated when the phase relationship is inconsistent for greater than 40% of the detected beats for about seven seconds.

Table 5-1 summarizes the combinations of heart rate sources that are continuously compared for the possibility of coincidence.

**Table 5-1. Heartbeat Coincidence Comparisons**

| Mode | FECG | US | US2 |
|---|---|---|---|
| **FECG** | | Model 173 | Model 174 |
| **US** | Model 173 | | Models 172, 174 |
| **US2** | Model 174 | Models 172, 174 | |

## Enabling/Disabling Heartbeat Coincidence Detection

The heartbeat coincidence detection feature can be enabled/disabled from a service setup mode. Refer to the "170 Series Service Manual" for more information.

## Display Indicator

When heartbeat coincidence detection is enabled, and the monitor detects two heartbeats that appear to be coinciding, this may indicate that both heart rate channels are picking up the same signal. When this coincidence occurs, the heart rate numerics for *both* heart rates flash *alternately* (one on while the other is off). As soon as coincidence is resolved, the numerics stop flashing.

If you disconnect a transducer while coincidence is detected, the numerics stop flashing.

**IMPORTANT**

ALARMS PRECEDENCE—Alarms take priority over heartbeat coincidence. If a fetal heart rate alarm occurs while coincidence is detected, the pair of numerics stops flashing *alternately*; only the alarming parameter numerics continue flashing. If both, fetal heart rates violate alarm limits, both heart rate numerics flash *synchronously*. Fetal heart rate alarms are also indicated by a flashing **Alarm** indicator and an audio indicator.

# Strip Chart Annotation

When heartbeat coincidence detection is enabled, and both heart rate channels are active, the annotation **HBC** prints in the center margin of the strip chart paper following the active FHR modes. (Refer to Figure 5-3.)

As soon as heartbeat coincidence is detected, two overlaid hearts ♡♡ print in the upper portion of the top grid of the strip chart paper; the hearts print twice per page for as long as coincidence is detected. Once coincidence is resolved, two side-by-side hearts ♡♡ print once. (Refer to Figure 5-3.)

If you disconnect a transducer while coincidence is detected, the overlaid hearts ♡♡ stop printing and the side-by-side hearts ♡♡ print once. In addition, the mode status line prints on the strip chart paper—without the **HBC** annotation—indicating the deactivated mode.

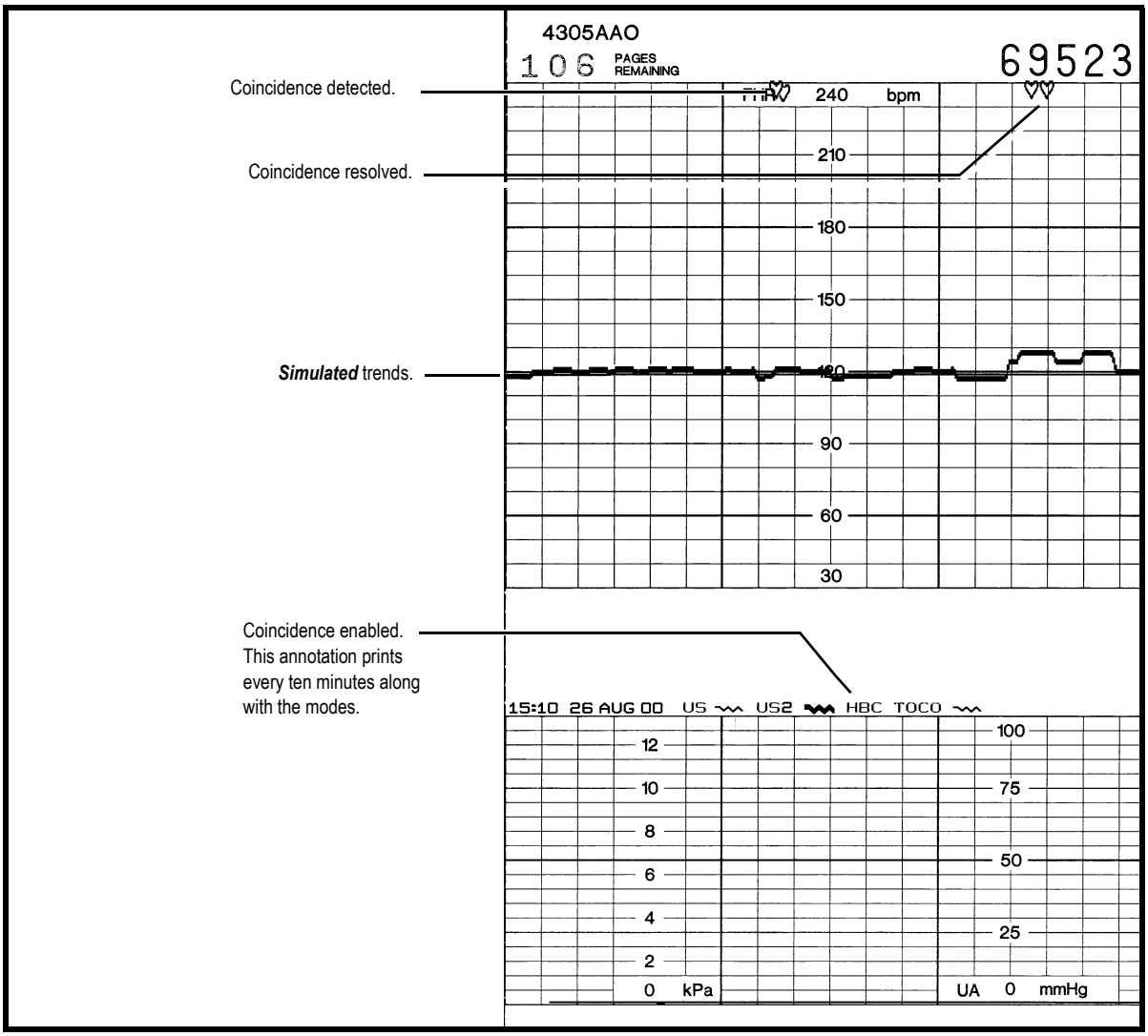



**Figure 5-3. Simulated Heartbeat Coincidence Detection Trace**

# Fetal Heart Rate Alarms

## FHR Threshold Alarms

**NOTE:** The alarm enable/disable setting controls all FHR alarms: high, low, and signal quality.

A fetal heart rate *threshold* alarm occurs when any fetal heart rate falls outside of the pre-defined alarm limits—greater than the high limit setting or less than the low limit setting. These alarm limits are configured via the user setup mode; the alarm can be completely disabled as well. Refer to "Customizing the Monitor" on page 4-10.

A threshold alarm is indicated both visually and audibly. Visual indications are provided by flashing the **Alarm** indicator and the respective heart rate numerics. The audio alarm is described as alternating high-low tones.

**CAUTION**

Prior to monitoring each patient, it is recommended that you check the alarm status and alarm limits to ensure they are appropriate for the patient. The alarms are disabled if the **Alarm Disable** indicator is lit; they are enabled if the indicator is unlit. When enabled, the alarm limits print in the center margin of the strip chart paper—at the 10-minute mark along with the time. (See Figure 5-4.)

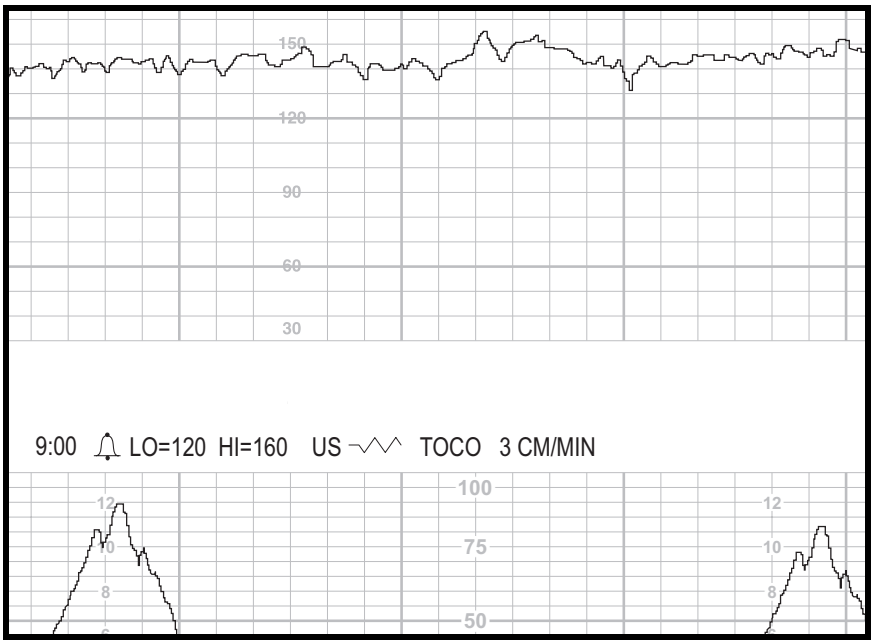



**Figure 5-4. Heart Rate Alarm Limits**

## Latching Alarms

Fetal heart rate threshold alarms are "latching." This means that a clinician must acknowledge the alarm using the monitor's **Alarm Silence** button in order to clear the alarm.

- **Active Threshold Alarm:** Press the **Alarm Silence** button to cancel the audio component of an active threshold alarm. The visual indications remains present until the FHR value returns to within the defined acceptable range.
- **Unsilenced, Resolved Threshold Alarm:** If a threshold alarm condition resolves, prior to being silenced (clinical acknowledgment), the visual and audible indications both remain present. Press the **Alarm Silence** button to cancel both the audible and visual indications.

## FHR High Alarm

The simplest example of a high FHR alarm occurs when the FHR value is *continuously* greater than the threshold (high limit) for 5 minutes. When data consistently violates the limit, the time-to-alarm is 5 minutes. See Figure 5-5.

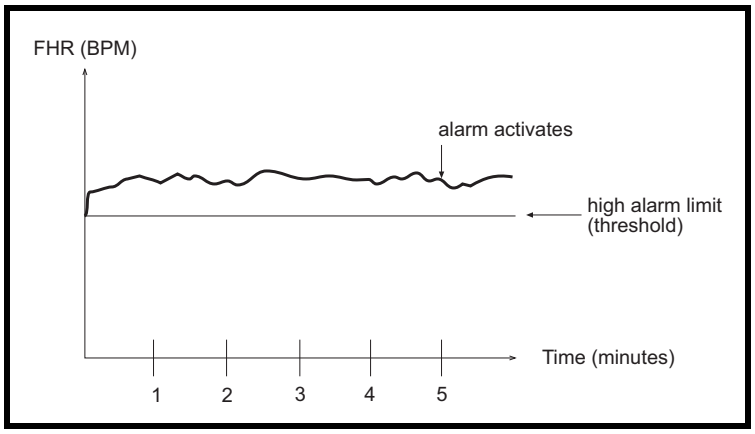



**Figure 5-5. High FHR Alarm Example**

## FHR Low Alarm

The simplest example of a low FHR alarm occurs when the FHR value is *continuously* less than the threshold (low limit) for 30 seconds. When data consistently violates the limit, the time-to-alarm is 30 seconds. See Figure 5-6.

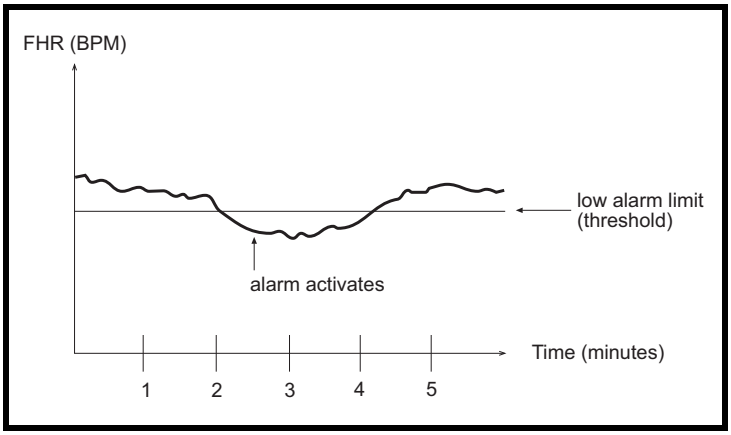



**Figure 5-6. Low FHR Alarm Example**

## Sample Clinical Exceptions

Figure 5-7 provides an example of FHR fluctuations above and below the high alarm limit setting.

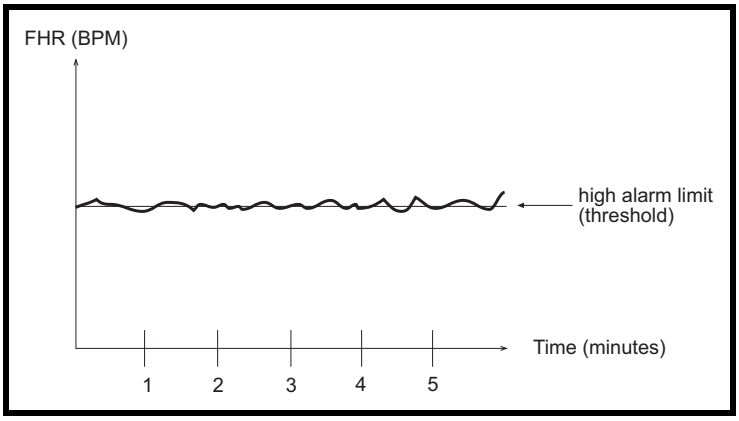



**Figure 5-7. Fluctuations Near High Alarm Limit Example**

Whether or not the pattern shown in Figure 5-7 generates an alarm depends on what percentage of the data violates the limit. The monitor evaluates the data on an on-going basis; the methodology can be simplified as follows:

- A FHR threshold alarm occurs if the FHR violates the alarm limit setting for more time than it stays within the specified acceptable range.
- The time-to-alarm increases as a greater percentage of data stays within the specified acceptable range.

# Signal Quality Alarms

A fetal heart rate *signal quality* alarm occurs if the monitor is unable to detect an acceptable FHR signal.

## Active Signal Quality Alarm

Signal quality alarms are indicated both visually and audibly. The **Alarm** indicator illuminates and dashes "– – –" display in the affected fetal heart rate display. The audio alarm is described as alternating high-low tones.

## Resolved Signal Quality Alarm

As soon as an alarm condition is resolved, both the visual and audible indications *automatically* disappear.

## 100% Signal Loss

In cases where there is a complete absence of signal, the signal quality time-to-alarm is 1.25 minutes. See Figure 5-8.

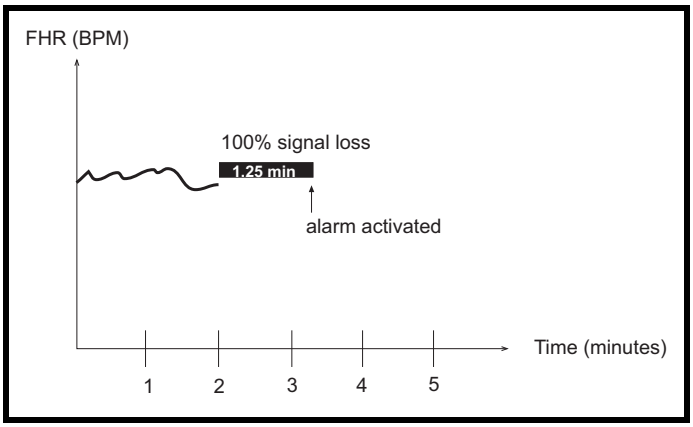



**Figure 5-8. 100% Signal Loss Example**

## Intermittent Signal Loss

In the clinical environment, a partial loss of signal is seen more frequently than a complete loss of signal. The time-to-alarm will vary related to the percentage of signal loss. Figure 5-9 shows an example where there is 70% signal loss resulting in a signal quality alarm after 5 minutes.

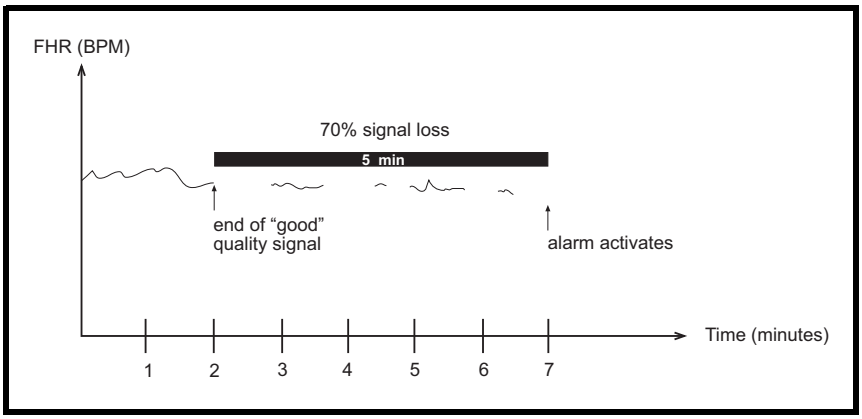



**Figure 5-9. 70% Signal Loss Example**

# Silencing an Audio Alarm

Press the **Alarm Silence** button to cancel the audio component of an alarm; the visual indications remain until the alarm condition is resolved.

The silence function works on an alarm-by-alarm basis. An audio alarm will sound if a new alarm condition occurs after the previous condition has been resolved.

# Summary

The alarm algorithms are intended to assist the perinatal staff in assessing the status of a patient at bedside by recognizing vital signs data that falls outside the user-defined normal range. The monitor does not replace observation and evaluation of the mother and fetus at regular intervals, by a qualified care provider, who will make diagnoses and decide on treatments or interventions. A provider should determine the status of the patient by visual assessment of the fetal monitor tracing at the bedside and evaluation of fetal and maternal vital signs and progress in labor. The absence of an alarm does not indicate fetal or maternal well-being.

Frequent assessment of the fetal monitor tracing is necessary to ensure recognition of unusual, undefined, or suspicious patterns that may or may not generate a threshold alarm.

**For your notes**

# Chapter 6

# Uterine Activity Monitoring

This section provides a brief overview of the uterine activity monitoring methods available on 170 Series Fetal Monitors. Refer to the "Maternal/Fetal Monitoring Operator's Manual" for additional information.

The 170 Series offers the following:

- 171/172: TOCO
- 173/174: TOCO and IUP

This section summarizes the uterine activity monitoring methods available in the 170 Series:

Tocotransducer (External Method) . . . . . 6-2
Intrauterine Pressure Monitoring (Internal Method) . . . . . 6-4

# Tocotransducer (External Method)

## Methodology

A tocotransducer applied to the maternal abdomen records relative changes in abdominal tension caused by uterine contractions. The value is displayed in relative units from 0–100. Uterine activity is continuously plotted on the bottom (or right) of the strip chart paper as a plain black line.

GE Medical Systems *Information Technologies* offers two models of tocotransducers: Nautilus and Trimline. Each model is available in a loop-style and button-style. Both styles are discussed in the "Maternal/Fetal Monitoring Operator's Manual".

**IMPORTANT**
FOR TRIMLINE TOCOTRANSDUCERS ONLY—You must wait at least ten seconds from the time you power the monitor on or connect a tocotransducer before pressing the **UA Reference** button.

## Establishing a Baseline

Monitoring uterine activity using a tocotransducer provides ***relative*** pressure measurements—compared to a baseline or UA reference. The quality of measurements depends on the following:

- position of the tocotransducer;
- belt tension;
- size of the patient; and
- established baseline.

All 170 Series Monitors provide a **UA Reference** button which sets the baseline. When a baseline is established, all pressure measurements are relative to that baseline. The baseline can be set manually by two different methods or automatically, when necessary. Whenever the baseline is set, the bottom line of the bottom strip chart grid is annotated with UA REF.

## Initial Referencing

for Trimline Tocotransducers only, it is important to establish an initial baseline when the tocotransducer is plugged into the monitor, *but not yet applied to the patient*. In other words, no pressure is applied to the transducer button.

For other transducers, the initial reference automatically occurs. After you plug in a transducers, verify that the display reads less than 30 relative units. Make a note of the reading.

The purpose of establishing a baseline at this point is necessary for consistency when applying and tightening the belt. You will have to set the baseline again, after tightening the belt.

## Accounting for Belt Tension

When you adjust the belt on the patient, regardless of transducer type, you want to ensure a comfortable fit; you also want to ensure that the transducer is held securely in place. GE Medical Systems *Information Technologies* recommends adjusting the belt tension so that, between contractions, the UA display shows approximately 25 relative units ***above*** the initial baseline.

After the belt is adjusted, it is important to establish a new baseline. This is because you don't want belt tension to be counted as uterine pressure; also the pressure readings could tend to go off the scale if you do not account for the belt tension. Again, the **UA Reference** button should only be pressed between contractions.

# More About Referencing

## Out of Range Condition

After you press the **UA Reference** button, if there is insufficient range to provide at least 100 relative units above the reference level (probably because the belt is too tight), the UA display area flashes "– –". If this happens, remove the tocotransducer from the patient; re-reference with no pressure applied to the button; re-apply the transducer to approximately 25 relative units ***above*** the baseline; then re-reference one more time. If you still receive the same result, try a different tocotransducer or contact your Service Representative.

## Manually Setting the Baseline at the Default Value

Briefly pressing the **UA Reference** button sets the baseline at the *default* setting—the default is configured via the service setup mode. The monitor is shipped from the factory with a *default* setting of 10 relative units. Qualified service personnel can access the service setup mode to set the baseline *default* to 5, 10, 15, 20, or 25 relative units. Refer to the "170 Series Service Manual" for more information.

## Manually Overriding the Baseline Default Value

Pressing and holding the **UA Reference** button for more than two seconds causes the UA reference level and display to override the default setting and cycle through all available selections: 5, 10, 15, 20, or 25 relative units, starting at the default setting—until the button is released. Once the button is released, the UA trace and UA value take on this new value as a baseline for reference.

Briefly pressing the **UA Reference** button reverts back to using the *default* setting configured via the service setup mode.

## Automatic Baseline "Zeroing"

If pressure falls below 0 relative units (probably because the belt has loosened), automatic UA referencing occurs and a new baseline reference is set at 0 relative units.

# Intrauterine Pressure Monitoring (Internal Method)

## Methodology

A catheter inserted transcervically into the uterine cavity measures intrauterine pressure. You can monitor using either a fluid-filled catheter or a transducer-tipped catheter. The uterine activity value is displayed in mmHg from 0–100 and the trend is continuously plotted on the bottom (or right) grid of the strip chart paper as a plain black line.

Pressure exceeding 100 mmHg is printed as a straight line at 100 mmHg.

## Why Zeroing is Important

When you zero the system, you are referencing the pressure to 0 mmHg while the system is open to air to ensure an absolute pressure measurement.

**For your notes**

# Chapter 7

# Strip Chart Recorder

This chapter discusses the different types of strip chart paper as well as the trends and annotations which are printed.

This section includes the following information:


Strip Chart Paper . . . . . 7-2
Trends . . . . . 7-5
Annotations . . . . . 7-6
Paper Error Conditions . . . . . 7-12
Removing Unused Paper from the Recorder . . . . . 7-13

# Strip Chart Paper

Instructions for loading the strip chart paper are provided in "Chapter 4, Setup Procedures". This chapter discusses the two kinds of strip chart paper available from GE Medical Systems *Information Technologies*. The two kinds of paper are:

- z-fold chart paper with pre-printed 30–240 BPM heart rate scale (Refer to Figure 7-1.)
- z-fold chart paper with pre-printed 50–210 BPM heart rate scale (Refer to Figure 7-2.)

In the United States of America, the most common grid is the 30–240 BPM scale with the recorder speed set at 3 cm/min. As shown in Figure 7-1, a dark line is printed every 3 cm/min, which represents 1 minute in time at a speed of 3 cm/min. The uterine activity scale is also pre-printed from 0–100 mmHg; this same scale is used for relative units.

In other countries, the most common grid may be the 50–210 BPM scale with the recorder speed set at 1 cm/min. As shown in Figure 7-2, every other vertical line measures 1 cm, or 1 minute in time at a speed of 1 cm/min. The uterine activity scale is also pre-preprinted from 0–100 mmHg; this same scale is used for relative units.

Figure 7-1 and Figure 7-2 also call out the top grid, bottom grid, and the annotation area for each style paper. Note, one style paper has a larger annotation area than the other.

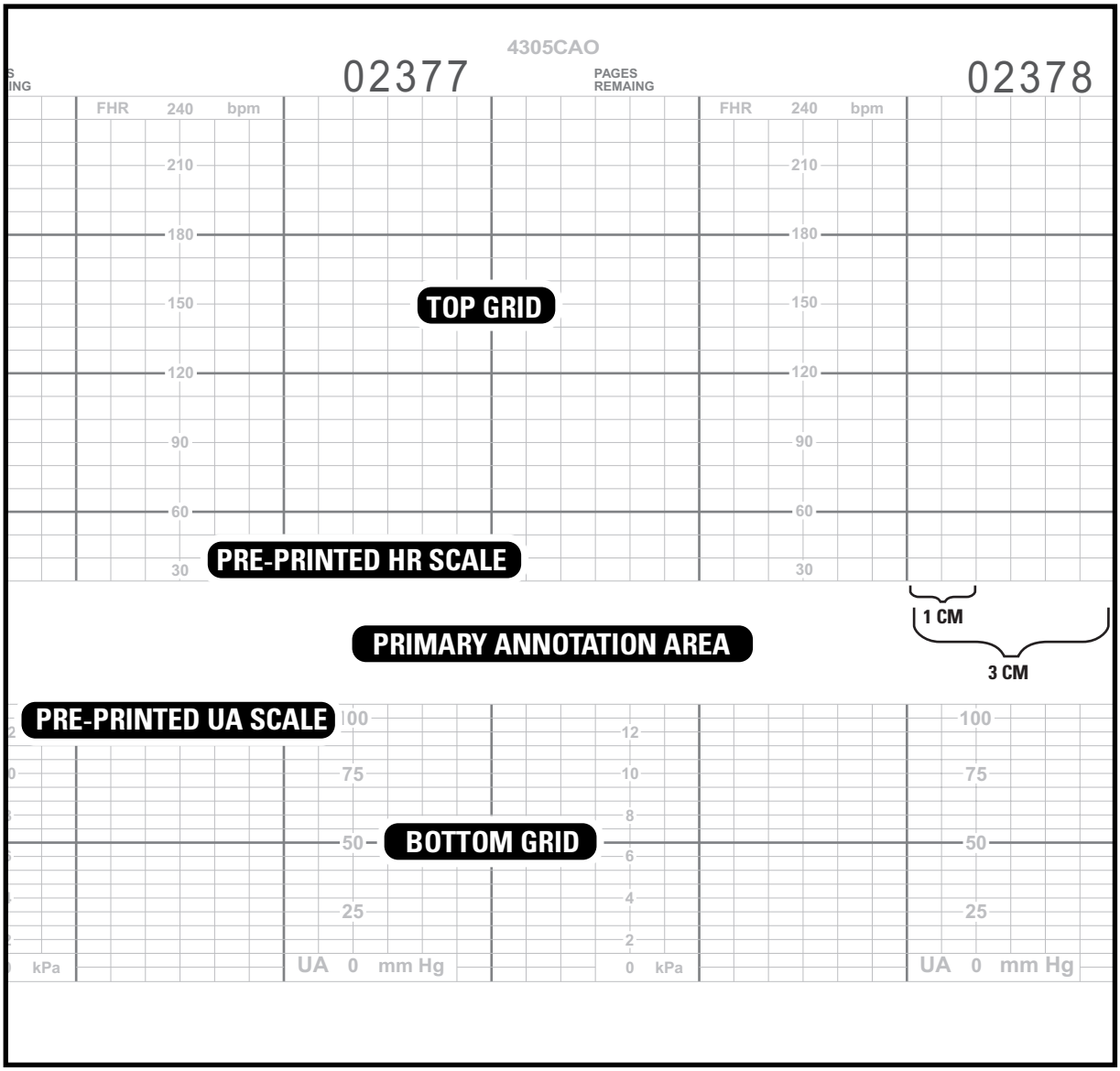



**Figure 7-1. Strip Chart Paper with 30–240 BPM Heart Rate Scale**

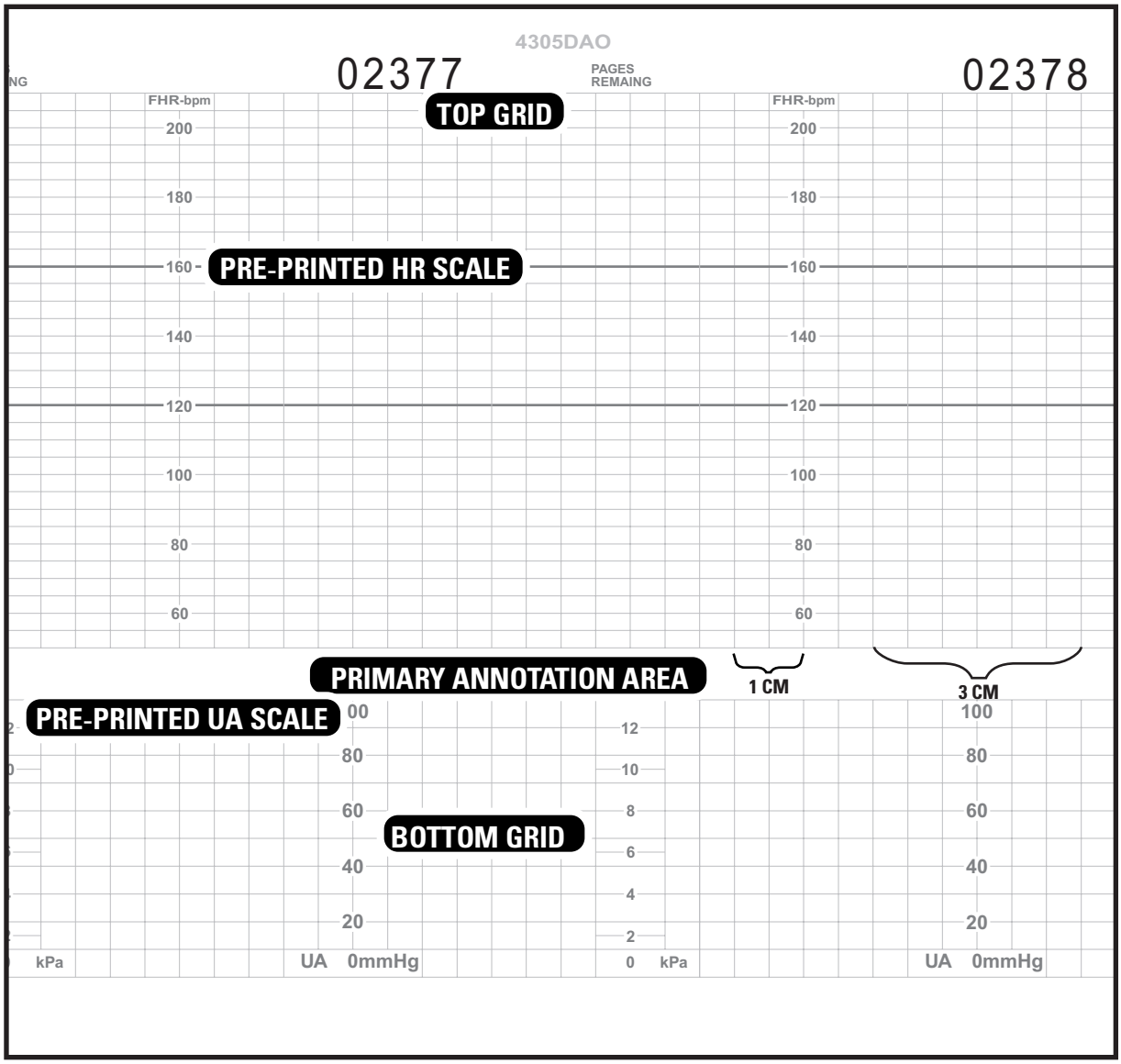



**Figure 7-2. Strip Chart Paper with 50–210 BPM Heart Rate Scale**

# Trends

**NOTE:** A fourth trend can be printed if the monitor is interfaced to a fetal oxygen saturation monitor. Refer to "Data from a Fetal Oxygen Saturation Monitor" on page 7-6.

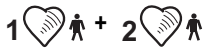
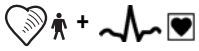
Up to three trends can be simultaneously printed on the strip chart paper—depending on your model monitor and the active modalities.

Two fetal heart rate trends can print in the top (or left) channel of the strip chart paper. The primary trend is printed in plain black; the secondary trend is printed in bold black. (Refer to Table 7-1.)

The uterine activity trend is printed on the bottom (or right) grid of the strip chart paper in plain black.

The fetal heart rate and uterine activity trends are printed continuously.

**Table 7-1. Heart Rate Trends**

| Model | Active Connectors | Primary Trend Annotation | Secondary Trend Annotation |
|---|---|---|---|
| 171 | | US | |
| 172 | | US | |
| | | US2 | |
| |  | US | **US2** |
| 173 | | US | |
| | | FECG | |
| |  | FECG | **US** |
| 174 | | US | |
| | | FECG | |
| | | US2 | |
| | | US | **US2** |
| | | FECG | **US2** |

# Annotations

Several standard annotations are made by the monitor to help analyze the strip chart data and to complete the patient record. Most annotations print in the area between the top and bottom grids on the strip chart paper; however, there are some annotations that print in either grid. A summary of annotations is provided in Table 7-2.

Paper with a heart rate scale of 30–240 BPM has a larger annotation area than paper with a heart rate scale of 50–210 BPM.

## Standard Annotations

All annotations are summarized in Table 7-2. The most common of the annotations which print on the bottom line (eight or five depending on the paper style) are:

- date
- time
- fetal heart rate alarm limits (if alarms are enabled)
- fetal heart rate mode(s)
- heart rate coincidence enable status
- uterine activity mode
- fetal movement enable status
- recorder speed
- telemetry annotations

## Peripheral Equipment Data

Your 170 Series Monitor has two built-in RS-232C ports which can be used to connect to other devices such as a maternal non-invasive blood pressure monitor, a fetal oxygen saturation monitor, or a central information system which supports Hewlett Packard's Digital Series Protocol. Contact your Service Representative for more information.

### Data from a Maternal Non-Invasive Blood Pressure Monitor

A blood pressure reading received from an external monitor prints on any of the first three annotation lines—as soon as a printing line is available. A solid diamond marker ♦ prints on the bottom two lines of the heart rate grid, marking the time of the reading.

♦
**NBP 103/ 71 M 83 P 72**

If the top three printing lines are busy printing other data, the diamond marker prints at the time of the reading; however, the vital signs data print sometime afterwards—when a line becomes available.

### Data from a Fetal Oxygen Saturation Monitor

Fetal oxygen saturation readings from an external monitor are sampled continuously and printed once every five minutes on the strip chart paper. The %FSp$O_2$ value

prints on any of the first three annotation lines—as soon as a printing line is available. A solid diamond marker ♦ prints on the bottom two lines of the heart rate grid, marking the time of the reading. (See Figure 7-3.)

♦
**FSpO2 47%**

If the top three printing lines are busy printing other data, the diamond marker prints at the time of the reading; however, the vital signs data print sometime afterwards—when a line becomes available.

The %FSpO2 trace prints on the bottom (or right) of the strip chart paper along with a scale marking the 0%, 50% and 100% marks. The %FSPO2 trace is a beaded trace annotated by FSpO2% —▪— on the mode line. (See Figure 7-3.) An adequate %FSpO2 signal is indicated by a continuous trace on the paper.

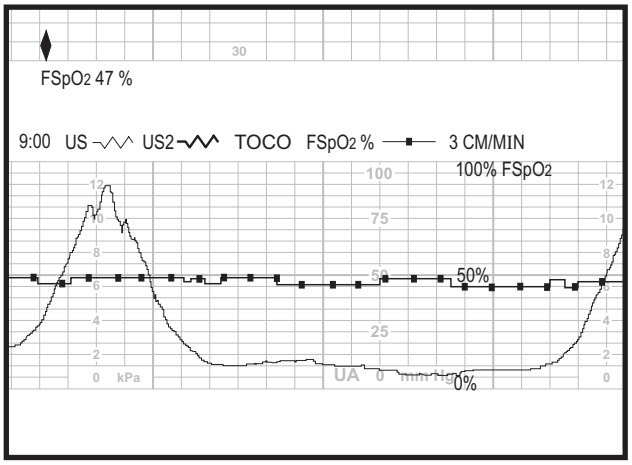



**Figure 7-3. FSpO2 Data Example**

## Annotations from a Central Information System

The 170 Series Monitor can be configured via a service setup mode to print annotations received from a central information system. These annotations print on any available line except the first. (The first annotation line is usually reserved for maternal blood pressure readings.) A computer marker prints on the bottom two lines of the heart rate grid to mark the time of the annotation and to indicate the annotation was made from a remote location.

**TEMP 102, FLUIDS GIVEN <SPW>**

# Multiple Annotations

Sometimes annotations occur within seconds of each other. Consider the following example which is illustrated by Figure 7-4:

- an automatic NBP reading occurs at 16:51:30
- three annotations are received from a central information system; the entries are made between 16:51:40 and 16:52:00
- a manual NBP reading occurs at 16:52:10

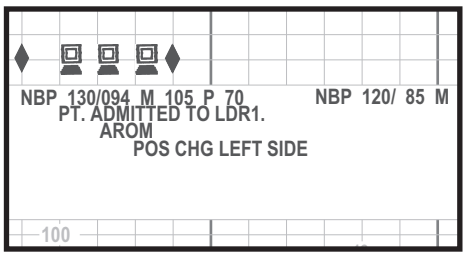



**Figure 7-4. Multiple Annotations Example**

| Table 7-2. Summary of Recorder Messages | |
|---|---|
| **Annotation** | **Explanation** |
| Time and Date<br>(Example: 2:40 21 FEB 98) | Time and date are both printed on the bottom annotation line twenty seconds after the recorder is turned on and when the date changes after midnight.<br>A time stamp automatically prints approximately every ten minutes—at the ten-minute mark. For example: 2:50, 3:00, 3:10, etc. If the bottom annotation line is being used to print another annotation, the time stamp is delayed. For example: 2:50, 3:02, 3:10, etc. In this example, the 3:00 date stamp was delayed until 3:02.<br>The time and/or date also prints following paper advancement or whenever the time or date is changed via the user setup mode. |
| SET TIME DATE | If the monitor senses a clock circuit fault, when the recorder is turned on, this message replaces the normal time/date stamp. The time is printed as 00:00. The message re-prints every ten minutes, at the ten-minute mark, until the clock is reset. The time represents the elapsed time since the monitor was turned on; the time will revert to 00:00 after 24 hours. |
| TEST: ARE<br>ALL DOTS<br>PRINTED? → | This annotation prints in the middle of the annotation area during the monitor's self-test routine which is performed when you turn on the monitor. The annotation reminds you to check for a continuous unbroken line of recorder dots. |
| US ¬⩘⩘ | The trend source prints on the bottom annotation line. Refer to Table 7-1 for a summary of active connectors and the corresponding mode annotations and trends.<br>The trend sources print:<br>■ twenty seconds after you turn on the recorder;<br>■ every ten minutes; and<br>■ whenever there is a mode change. |
| US2 ¬⩘⩘ | |
| FECG ¬⩘⩘ | |
| TOCO | |
| IUP | |
| CARDIO INOP | This annotation prints in place of the FHR trend source if fetal heart rate monitoring is not active (i.e. no active connectors). |
| UA INOP | This annotation prints in place of the UA trend source if uterine activity monitoring is not active (i.e no transducer plugged into the connector). |
| $FSpO_2$% —▪— | The annotation, printed on the bottom annotation line, indicates a fetal oxygen saturation monitor is the trend source. |
| $FSpO_2$% INOP | This annotation prints *once* on the bottom annotation line indicating that there is no longer a connection with an external fetal oxygen saturation monitor. |

| Table 7-2. Summary of Recorder Messages (Continued) | |
|---|---|
| **Annotation** | **Explanation** |
| Fetal Heart Rate Alarm Status/Limits. For example:<br><br>HI=160 LO=120 | This annotation prints at startup indicating the fetal heart rate alarm status and limits. The bell icon indicates that the alarm function is enabled. HI represents the high alarm limit in BPM; LO represents the low alarm limit in BPM. The alarm settings are adjustable via the user setup mode. The annotation is reprinted every 10 minutes along with the time. If the alarms are disabled, the entire line is omitted. |
| Chart Speed<br>(Example: 3 CM/MIN) | The chart speed prints on the bottom annotation line twenty seconds after you turn on the recorder. It also prints following paper advancement. |
| **UA**<br>**REF** | This message prints on the bottom of the uterine activity grid whenever:<br>■ you press the UA Reference button ; or<br>■ automatic re-zeroing occurs during tocotransducer monitoring |
| BASELINE PRESSURE OFFSCALE | This annotation prints on the bottom line of the uterine activity grid during IUPC monitoring when the pressure falls below 0 mmHg for more than 20 seconds. |
| Maternal NBP vital signs data. For example:<br><br>NBP 103/ 71 M 83 P 72 | Maternal vital signs data prints as it is received from an external non-invasive blood pressure monitor. A solid diamond prints in the bottom two lines of the heart rate grid. The diamond marks the time of the blood pressure reading and also indicates that the information comes from an external device interfaced via one of the monitor's RS-232C ports. The vital signs data prints in one of the top three lines of the annotation area as soon as a printing line is available. |
| Fetal oxygen saturation data. For example:<br><br>$FSpO_2$ 47% | The %FSpO2 data received from an external fetal oxygen saturation monitor, prints once every five minutes. A solid diamond prints in the bottom two lines of the heart rate grid. The diamond marks the time of the fetal oxygen saturation reading and also indicates that the information comes from an external device interfaced via one of the monitor's RS-232C ports. The vital signs data prints in one of the top three lines of the annotation area as soon as a printing line is available. |
| Remote notes from a central information system. For example:<br><br>EPIDURAL GIVEN.<br>AROM.<br>POS CHG LEFT SIDE | This annotation represents notes received from a remote central information system. The computer icon prints in the bottom two lines of the heart rate grid. The icon marks the time of the annotation and also indicates that the information comes from a remote computer. The notes print on any line except the first. (The first line is reserved for NBP vital signs data.) |
| FMD | This annotation prints following the primary ultrasound mode annotation (US ) when fetal movement detection is enabled.) The annotation represents only that the feature is enabled; it does not indicate that fetal movement has been detected. |

| Table 7-2. Summary of Recorder Messages (Continued) | |
|---|---|
| **Annotation** | **Explanation** |
| | This annotation prints on the bottom two lines of the heart rate grid indicating that active telemetry signals are being received. The annotation re-prints every ten minutes along with the modes. |
| | This annotation prints once on the bottom two lines of the heart rate grid indicating that telemetry signals are no longer being received. |
| **US + 20**<br>\|  \|<br>\|  \|<br>\|  \|<br>\|  \|<br>\|  \| | This annotation can only be seen on a Model 173 or 174 while dual heart rate monitoring (FECG and ultrasound) is in progress. The offset annotation **US + 20** prints at the top of the heart rate grid indicating that the secondary fetal heart rate trend (ultrasound) is shifted +20 BPM. The vertical dashed lines bracketing the heart rate grid indicate the start/end of the fetal heart rate offset mode, respectively. |
| **US2+20**<br>\|  \|<br>\|  \|<br>\|  \|<br>\|  \|<br>\|  \| | This annotation can only be seen on a Model 172 or 174 while dual heart rating monitoring (dual ultrasound) is in progress. The offset annotation **US2+20** prints at the top of the heart rate grid indicating that the secondary fetal heart rate trend (second ultrasound channel) is shifted +20 BPM. The vertical dashed lines bracketing the heart rate grid indicate the start/end of the fetal heart rate offset mode, respectively. |
| | This annotation prints on the bottom two lines of the heart rate grid indicating an event. Generate the mark by one of the following:<br>■ Briefly press the monitor's Mark/Offset button .<br>■ Press the Remote Marker button. (The Remote Marker is an accessory that can be connected to a 170 Series Monitor. The monitor can be configured via a service setup mode to use this arrow annotation or the one shown in the next row of this table.) |
| | This annotation prints on the bottom two lines of the heart rate grid indicating that the mother perceives fetal movement. The annotation prints each time the mother presses the Remote Marker button. A horizontal bar is printed as a tail on the arrow for as long as the button is held down. (The Remote Marker is an accessory that can be connected to a 170 Series Monitor. The monitor can be configured via a service setup mode to use this arrow annotation or the one shown in the previous row of this table.) |
| | This annotation prints on the bottom two lines of the heart rate grid indicating that the Corometrics Model 146 Fetal Acoustic Stimulator is being used. The annotation prints each time a clinician presses the button on the stimulator. |

# Paper Error Conditions

A 170 Series Monitor indicates when the recorder is completely out of paper and when the strip chart paper is incorrectly loaded.

## Paper-Out Condition

When the recorder runs out of paper, the monitor automatically ejects the paper and then turns off the recorder. The Record indicator flashes until you load paper.

## Paper-Load–Error Condition

The instructions for loading paper into a 120 or 170 Series Monitor *are different* than the instructions for loading paper into other Corometrics monitors with which you may be familiar.

To protect against paper jams, the 170 Series recorder contains a paper-loading sensor which detects if the paper is incorrectly loaded. When the recorder detects a paper-load–error condition:

- the recorder does not print;
- the **Record** indicator flashes on and off every second; and
- three short beeps (with a low tone) sound every three seconds at a fixed volume until the condition is resolved (The volume cannot be adjusted.)

The most likely cause of a paper-load–error condition is that you loaded the paper with the black squares facing up. The correct method—for 120 and 170 Series Monitors— is to load the paper with the black squares down. To correct the problem:

1. Follow the instructions for "Removing Unused Paper from the Recorder" next on this page.
2. Follow the instructions for "Loading Strip Chart Paper" on page 4-2.

# Removing Unused Paper from the Recorder

If you need to remove *unused* paper from the recorder:

1. Slide the monitor forward so that the front is aligned with the edge of the cart or table on which it stands.
2. Press on each side of the paper drawer to release the drawer latches.
3. Slide the paper drawer out toward you. The drawer should extend out over the cart or table on which the monitor rests.
4. Reach underneath the paper drawer and locate the hole in the bottom of the drawer. Use your finger to push up on the paper through this hole; then grasp the paper with your other hand.

**For your notes**

# Chapter 8

# Cleaning

All equipment, no matter how reliable, needs to be maintained on a regular basis. This chapter describes general care and cleaning instructions for the 170 Series Monitor and its accessories. If an accessory is not listed, consult the manufacturer's instructions.

**CAUTION**
Unplug the monitor from the AC power source and detach all accessories from the monitor. Do not immerse accessories in any liquid. Do not use abrasive cloth or cleaners on monitor or accessories.

This chapter describes the following:


Monitor Exterior (Including Displays) . . . . . 8-2
Tocotransducer, Ultrasound Transducer, and Legplate . . . . . 8-2
UA Strain Gauge . . . . . 8-4

# Monitor Exterior (Including Displays)

To clean the exterior of the monitor:

1. Wipe any fluids from the surface of the monitor.
2. Dampen a cloth or paper towel with isopropyl alcohol and gently rub soiled area until clean.

# Tocotransducer, Ultrasound Transducer, and Legplate

**CAUTIONS**

ABRASION—Do not use abrasive cloth, sharp objects, or abrasive cleaners.

ALCOHOL—Do not use Alcohol in cleaning solutions.

DISCONNECTION—Detach the transducers/cables/legplate from the monitor.

IMMERSION—Do not immerse transducers/cables/legplate or hold under running water.

1. Dampen a cloth or paper towel with one of the following products; then wring out until only slightly wet:
   - Sodium Hypochlorite 5.25 % (Bleach) diluted 10:1
   - Cidex
   - Sporicidin
   - Soap and water
2. Rub soiled area until clean, taking care not to excessively wet the tocotransducer diaphragm seal or the contact surface of the ultrasound transducer.
3. Use a cloth dampened with water on the contact surface of the ultrasound transducer and around the seal of the tocotransducer. Do not use a sharp object which might damage the seal of the tocotransducer.
4. Dry all accessories with a soft, dry cloth.

# UA Strain Gauge

1. Remove the plastic dome.
2. If desired, wash the transducer with sterile water or saline solution.
3. Carefully clean the diaphragm seal with a cotton swab to remove deposits. Avoid excessive pressure since this may damage the diaphragm. If there are excessive stains on the diaphragm or sides of the transducer, remove with a cotton swab and solvents of increasing strength. Do not use pumice, Ajax, Bon Ami or other abrasives.
4. After cleaning, rinse the transducer thoroughly in distilled water and replace the dome loosely.
5. Dry the transducer with sterile gauze.

**CAUTIONS**

AUTOCLAVE—Do not autoclave pressure transducer.

IMMERSION—Do not immerse any part of the electrical connector of the transducer in the cleaning solution at any time. Examine the outer sheath of the cable for perforations. If the outer covering is damaged in any way, do not immerse the cable in the cleaning solution; this may result in moisture entering the transducer case, which is vented through the cable.

LIQUIDS—If liquids enter the electrical connector, check the resistance between the electrical element and the transducer case. A resistance level of greater than 10 MΩ ensures that the leakage current is within acceptable levels for safe use on patients.

6. Leave transparent dome attached to the transducer during storage, but slacken the locking ring at least one quarter of a turn.

**CAUTION**

STERILIZATION—Prior to patient use, ensure the dome is sterile.

# Chapter 9

# Troubleshooting

This section of the manual provides a troubleshooting guide for the most basic 170 Series Monitor operational problems. If the response to a specific question is not found, contact your Service Representative:

**Inside the United States:** Call 1-800-558-5120.

**Outside the United States:** Call 414-355-3790;
or contact your local distributor.

This section contains the following:


General Troubleshooting . . . . . 9-2
Ultrasound Troubleshooting. . . . . 9-3
FECG Troubleshooting . . . . . 9-4
External UA Troubleshooting . . . . . 9-6
Internal UA Troubleshooting . . . . . 9-6

# General Troubleshooting

**Table 9-1. General Troubleshooting**

| Problem | Probable Cause | Possible Solution |
|---|---|---|
| No monitoring functions and green Power indicator does not illuminate when Power switch is pressed. | Power cord (AC or DC) not connected or is defective.<br><br>The AC outlet is defective. | Check cord connections from monitor to converter and from converter to AC line power. Replace cord(s).<br><br>Use a different outlet. |
| Recorder does not function and the **Record** indicator flashes.<br><br>Recorder does not function however the **Record** Indicator flashes and an audio alarm sounds three beeps every three seconds.<br><br>The recorder does not function yet the **Record** indicator is on. | Recorder is out of paper.<br><br>Paper loaded backwards.<br><br>Service required. | Install paper. Refer to page 4-2.<br><br>Re-install paper. Refer to page 7-12.<br><br>Call for service. |
| The edges of the paper curl as paper advances out of recorder. | Paper is loaded skewed. | Open paper drawer. Ensure paper lays flat in the bottom of the tray. (See Figure 4-7.) Close the drawer making sure that the vertical lines on the paper are parallel to the printhead. (See Figure 4-8.) |
| Incorrect time and date printed on strip chart paper. | Time incorrectly set.<br><br>Clock circuit or battery fault. | Access the user setup mode and reset the time and date. Refer to page 4-10.<br><br>Call for service. |
| No heartbeat or pulse sounds. | Volume set too low.<br><br>Transducer not connected or is loose. | Increase the volume.<br><br>Ensure that each transducer is firmly attached to monitor. |
| Monitor fails self-test routine. | Service required. | Call for service. |

# Ultrasound Troubleshooting

**Table 9-2. Ultrasound Troubleshooting**

| Problem | Probable Cause | Possible Solution |
|---|---|---|
| Ultrasound not functioning properly. | Transducer not properly connected to monitor. | Ensure that transducer is firmly attached to monitor. |
| | Transducer placement. | Wait before moving transducer; FHR often returns. Reposition transducer. |
| | Too little gel applied to transducer. | Apply more gel. |
| | Defective transducer. | Replace transducer. |
| | Active fetus or mother. Fetal arrhythmia or hiccups. Extreme maternal obesity. | Use alternate technique. |
| | No signal. | Auscultate FHR. |
| | Service required. | Call for service. |
| Static noise on ultrasound. | Active fetus. | Reposition transducer. |
| | Environmental noise. | Keep sheets and gown off transducer. Do not hold transducer with hand. |
| | Maternal movement. | Use alternate monitoring mode. |
| | Defective transducer. | Replace transducer. |

# FECG Troubleshooting

**Table 9-3. FECG Troubleshooting**

| Problem | Probable Cause | Possible Solution |
|---|---|---|
| Internal FECG erratic or not recording properly. | Transducer not properly connected to monitor. | Ensure transducer is firmly attached to the monitor. |
| | Legplate not firmly secured to legplate post. | Secure legplate to patient. |
| | Electrode wire not secure in legplate post. | Inspect legplate connection. |
| | Paste is dried or incorrect paste is being used. | Check ECG paste; re-apply, if necessary. |
| | Electrode not properly attached. | Replace electrode. |
| | No FECG signal. | Auscultate FHR. |
| | Defective electrode. | Replace electrode. |
| | Defective legplate. | Replace legplate. |
| | Defective attachment pad. | Replace attachment pad. |
| | Service required. | Call for service. |

# External UA Troubleshooting

**Table 9-4. External UA Troubleshooting**

| Problem | Probable Cause | Possible Solution |
|---|---|---|
| Tocotransducer not recording contractions. | Transducer not properly connected to monitor.<br>Transducer not properly placed.<br>Transducer not secured to patient.<br>Defective transducer/cable assembly.<br>No maternal contractions.<br>UA Reference range exceeded. | Ensure that transducer is firmly attached to monitor.<br>Reposition transducer.<br>Secure or re-apply transducer to patient.<br>Replace transducer/cable assembly.<br>Wait.<br>Loosen belts or remove transducer from patient. Press **UA Reference** pushbutton while no pressure is applied to transducer button. Re-apply transducer. Do not overtighten belt. Press **UA Reference** pushbutton again between contractions. |
| Flashing "+" sign. | Relative pressure > 100. | Press the **UA Reference** pushbutton between contractions. |
| Flashing dashes **"– –"** show in place of numerics in uterine activity display. | UA Reference pushbutton pressed before UA circuits stabilized. (Trimline Tocotransducer only.)<br>UA Reference range exceeded due to over-tightening belt.<br>Transducer defective.<br>Service required. | You must wait ten seconds following powering on the monitor and/or connecting to the **UA** connector.<br>Loosen belts or remove transducer from patient. Press **UA Reference** pushbutton while no pressure is applied to transducer button. Re-apply transducer. Do not overtighten belt. Press **UA Reference** pushbutton again between contractions.<br>Replace transducer.<br>Call for service. |

# Internal UA Troubleshooting

**Table 9-5. Internal UA Troubleshooting**

| Problem | Probable Cause | Possible Solution |
|---|---|---|
| Internal pressure not measuring correctly. | Transducer not properly connected to monitor.<br>Air bubble in dome; or catheter blocked.<br>Dome is cracked.<br>Strain gauge not at same height as catheter tip.<br>Catheter has fallen out of place.<br>Catheter or strain gauge not zeroed.<br>Service required. | Ensure transducer is securely attached to monitor.<br>Flush dome and catheter.<br>Replace dome.<br>Adjust strain gauge height.<br>Replace catheter.<br>Calibrate catheter or strain gauge.<br>Call for service. |
| | Blockage in fluid-filled catheter.<br>Fetus pressing directly on catheter.<br>Defective strain gauge or catheter.<br>Service required. | Flush catheter. Re-zero. Replace catheter if necessary.<br>Reposition by twisting catheter.<br>Replace strain gauge or catheter.<br>Call for service. |

# Chapter 10

# Supplies and Accessories

This section provides an overall listing of supplies and accessories for use with 170 Series Monitors. To place an orderl:

**Inside the United States:** Call 1-800-558-5120.

**Outside the United States:** Call 414-355-3790;
or contact your local distributor.

**Table 10-1. Supplies & Accessories**

| Item | Catalog Number (REF) |
|---|---|
| 170 Series Service Manual | 200947-004 |
| Remote Event Marker | 3919BAO |
| 170 Series Transducer Holder, Desktop Mount | 1705ARO |
| 170 Series Mobile Cart, with Transducer Holder | 1706ARO |
| 170 Series Wall Mount System, with Transducer Holder | 1707ARO |
| Model 3116 LDR/LDRP Bedroom Style Mobile Cart—Finished | 3116AAO |

| | |
|---|---|
| Model 3116 LDR/LDRP Bedroom Style Mobile Cart—Unfinished | 3116BAO |
| Model 146 Fetal Acoustic Stimulator | 0146AAY |
| Z-Fold Chart Paper Pack, 30–240 BPM Heart Rate Scale (40/carton) | 4305CAO |
| Z-Fold Chart Paper Pack, 50–210 BPM Heart Rate Scale (40/carton) | 4305DAO |
| Chart Guard Label Packet | 4914BAO |
| Loop-Style Ultrasound Transducer (Nautilus), 8-foot Cord | 5700LAX |
| Button-Style Ultrasound Transducer (Nautilus), 8-foot Cord | 5700HAX |
| Ultrasound Coupling Gel Bottle, 250 ml (12/carton) | 2434AAO |
| Ultrasound Coupling Gel Bottle, 5 liter | 2475AAO |
| Reusable Belt for Loop-Style Transducer, Mesh Style (10/carton) | 4425AAO |
| Reusable Belt for Loop-Style Transducer, Velcro Style (10/carton) | 4425CAO |
| Reusable Belt for Button-Style Transducer, Elastic Style (10/carton) | 4425EAO |
| Semi-Reusable Belt for Loop-Style Transducer, Velcro Style (2/pack; 50 packs/carton) | 4425FAO |
| Single-Patient Use Belt for Loop-Style Transducer, Foam Style with Velcro Closure | 8024AAO |
| Qwik Connect *Plus* Spiral Electrode (50/carton) | 7000AAO |
| Legplate for Qwik Connect *Plus* Spiral Electrode, 8-foot Cord | 1590AAO |
| Button-Style Legplate for Qwik Connect *Plus* Spiral Electrode, 8-foot Cord | 1590CAO |
| Strap Adaptor for Qwik Connect *Plus* Spiral Electrode Legplates | 1594AAO |
| ECG Conductive Cream Bottle, 118 ml (12/carton) | 4514AAO |
| Reusable Legplate Strap with Velcro Closure (24/carton) | 2023AAO |
| Single-Patient Use Legplate Strap | 8036AAO |
| Attachment Pads for Qwik Connect *Plus* Spiral Electrode Legplate (50/carton) | 2464AAO |
| Loop-Style Tocotransducer (Nautilus), 8-foot Cord | 2264LAX |
| Button-Style Tocotransducer (Nautilus), 8-foot Cord | 2264HAX |
| Reusable Belt for Loop-Style Transducer, Mesh Style (10/carton) | 4425AAO |
| Reusable Belt for Loop-Style Transducer, Velcro Style (10/carton) | 4425CAO |
| Reusable Belt for Button-Style Transducer, Elastic Style (10/carton) | 4425EAO |
| Semi-Reusable Belt for Loop-Style Transducer, Velcro Style (2/pack; 50 packs/carton) | 4425FAO |
| Single-Patient Use Belt for Loop-Style Transducer, Foam Style with Velcro Closure | 8024AAO |
| Saflex IUPC with Amnio Infusion/Sampling Capabilities (10/carton) | 2076BAO |

| | |
|---|---|
| Corometrics Saflex Intermediate Cable | 1336AAO |
| Holder Assembly for Disposable Pressure Transducer | 4518BAO |

# Chapter 11

# Technical Specifications

This section contains a detailed list of the technical specifications for the 170 Series Monitor.

This chapter lists specifications for the following:


General Monitor . . . . . 11-2
Operating Modes . . . . . 11-3
Strip Chart Recorder. . . . . 11-4

# General Monitor

| Table 11-1. General Monitor Specifications | | |
|---|---|---|
| **Category** | **Technical Specifications** | |
| **Power Requirements** | | |
| Nominal Line Voltage: | 100–230 VAC | |
| Line Frequency: | 50/60 Hz (operates over 47–63 Hz) | |
| Power Consumption (maximum): | ≤30 VA | |
| Monitor DC Input: | 12 Vdc at 2.5 A | |
| **Physical Characteristics** | | |
| Height: | 5.75 in (14.6 cm) | |
| Width: | 16.75 in (42.5 cm) | |
| Depth: | 10.0 in (25.4 cm) | |
| Weight: | 8 lbs (3.6 kg) approx. | |
| **Environmental Conditions** | **Operating** | **Storage** |
| Monitor: | | |
| Ambient Temperature: | 50°F to 104°F (10°C to 40°C) | 14°F to 131°F (–10°C to 55°C) |
| Relative Humidity: | 10% to 75%, non-condensing | 10% to 90%, non-condensing |
| Strip Chart Paper[a]: | | |
| Ambient Temperature: | 50°F to 104°F (10°C to 40°C) | < 80°F (< 26.5°C) |
| Relative Humidity: | 30% to 70%, non-condensing | 45% to 65%, non-condensing |
| **Certification** | | |
| UL-2601.1: | Designed to meet UL-2601.1<br>Medical electrical equipment classified by Underwriter's Laboratories, Inc., with respect to fire, shock, and mechanical hazards in accordance with UL-2601.1. | |
| CUL: | Classified with respect to electric shock, fire, mechanical, and other specified hazards only, in accordance with CAN/CSA C22.2 No. 601.1 | |

[a] *Paper operating environmental conditions are for a period of less than one month. Paper storage environmental conditions are for extended storage.*

# Operating Modes

| Table 11-2. Operating Mode Specifications | | |
|---|---|---|
| **FECG Mode** | | |
| Technique: | Peak detecting, beat-to-beat cardiotachometer | |
| Heart Rate Counting Range: | 30–240 BPM | |
| Heart Rate Resolution: | 1 BPM | |
| Artifact Elimination: | Service selectable, ±25 BPM artifact rejection | |
| Countable Input Signal Range: | 15 µV to 2 mV peak-to-peak | |
| Offset Voltage Tolerance (Differential): | ±300 mVdc maximum | |
| Maximum Common Mode Voltage: | 20 V peak-to-peak | |
| Common Mode Rejection: | | |
| Balanced: | > 120 dB at mains frequency, with patient cable | |
| Unbalanced 5kΩ RA or LA: | > 110 dB at mains frequency | |
| Input Impedance: | | |
| Differential: | > 10 MΩ | |
| Common Mode: | > 20 MΩ | |
| Mains Frequency Rejection: | > 40 dB | |
| Leakage Current: | Complies with EN60601.1 and/or EN60601.1.1 harmonized national standard | |
| Isolation, Mains-to-Patient: | > 5656 Vdc | |
| **Ultrasound Mode** | | |
| Technique: | Pulsed Doppler with autocorrelation processing | |
| Transducer Type: | 9-crystal | |
| Pulse Repetition Frequency: | 2 kHz (all modes) | |
| Pulse Duration: | 92 µs | |
| Transmitter Frequency: | 1.151 MHz | |
| Spatial-Average Temporal Average Intensity: | Isata< 5 $mW/cm^2$ | |
| Focal 20 dB Beam Area: | 16.6 $cm^2$, at a range = 7 cm | |
| Peak Instantaneous Intensity: | 1.8 $mW/cm^2$ | |
| Heart Rate Counting Range: | 50–210 BPM | |
| Leakage Current: | Complies with EN60601.1 and/or EN60601.1.1 harmonized national standard | |
| Isolation[a], Mains-to-Patient: | > 5656 Vdc[a] | |
| **Uterine Activity Mode** | **Strain Gauge** | **Tocotransducer** |
| Range: | 0–100 mmHg | 0–100 relative units |
| Resolution: | 1 mmHg | 1 relative unit |
| Bandwidth: | dc to 3 Hz | dc to 0.5 Hz |
| Excitation Voltage: | +4.0 Vdc | +4.0 Vdc |
| Zero Set Temperature Drift: | < 0.1 mmHg/°C (0.013 kPa/°C), excluding transducer | |
| Leakage Current: | Complies with EN60601.1 and/or EN60601.1.1 harmonized national standard | |
| Isolation[b], Mains-to-Patient: | > 5656 Vdc[b] | |

[a] *The ultrasound connector is isolated for the primary ultrasound channel (combi-connector) on Model 174 Monitors only.*

[b] *The uterine activity connector is isolated on Model 173 and 174 Monitors only (units equipped with IUP).*

# Strip Chart Recorder

| Table 11-3. Strip Chart Recorder Specifications | | |
|---|---|---|
| **Heart Rate Scale** | **Domestic** | **International** |
| Chart Width: | 7 cm | 8 cm |
| Scaling: | 30 BPM/cm | 20 BPM/cm |
| Range: | 30–240 BPM | 50–210 BPM |
| Resolution: | 1 BPM | 1 BPM |
| **Uterine Activity Scale** | **Strain Gauge** | **Tocotransducer** |
| Chart Width: | 4 cm | 4 cm |
| Scaling: | 25 mmHg/cm | 25 relative units/cm |
| Range: | 0–100 mmHg | 0–100 relative units |
| Resolution: | 1 mmHg | 1 relative unit |
| **Recorder Drive** | | |
| Speeds: | 1, 2, and 3 cm/min | |
| Speed Accuracy: | ±2 % over 10 minutes | |

**NOTE:** Specifications subject to change without notice.

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